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Tenen paper els col·loides en la fluïdoteràpia perioperatoria actual?

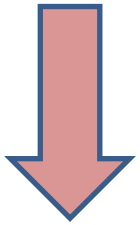
Carme Colilles

6 d'octubre 2014


A VER. TERMÓMETRO, PIJAMA, SUEROS, OXÍGENO... HUM! VALE. PUEDE INGRESAR
RECEPCIÓN
KALIN '09

Objectius de la fluïdoteràpia perioperatòria

Mantenir normovolèmia
Mantenir perfusió tissular



- Reposar dejuni
- Reposar pèrdues insensibles
- Reposar pèrdues extraordinàries
- Reposar tercer espai

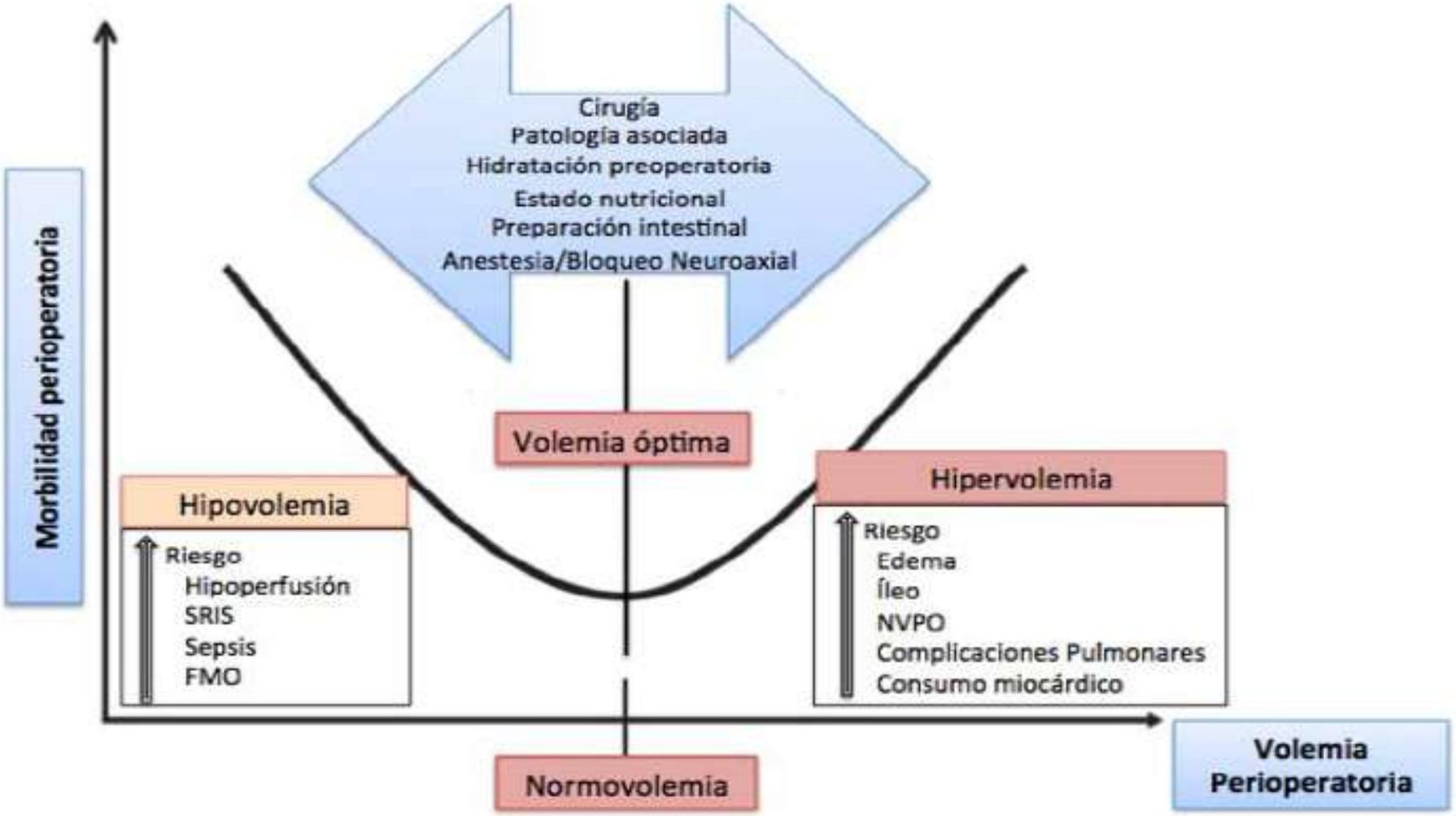
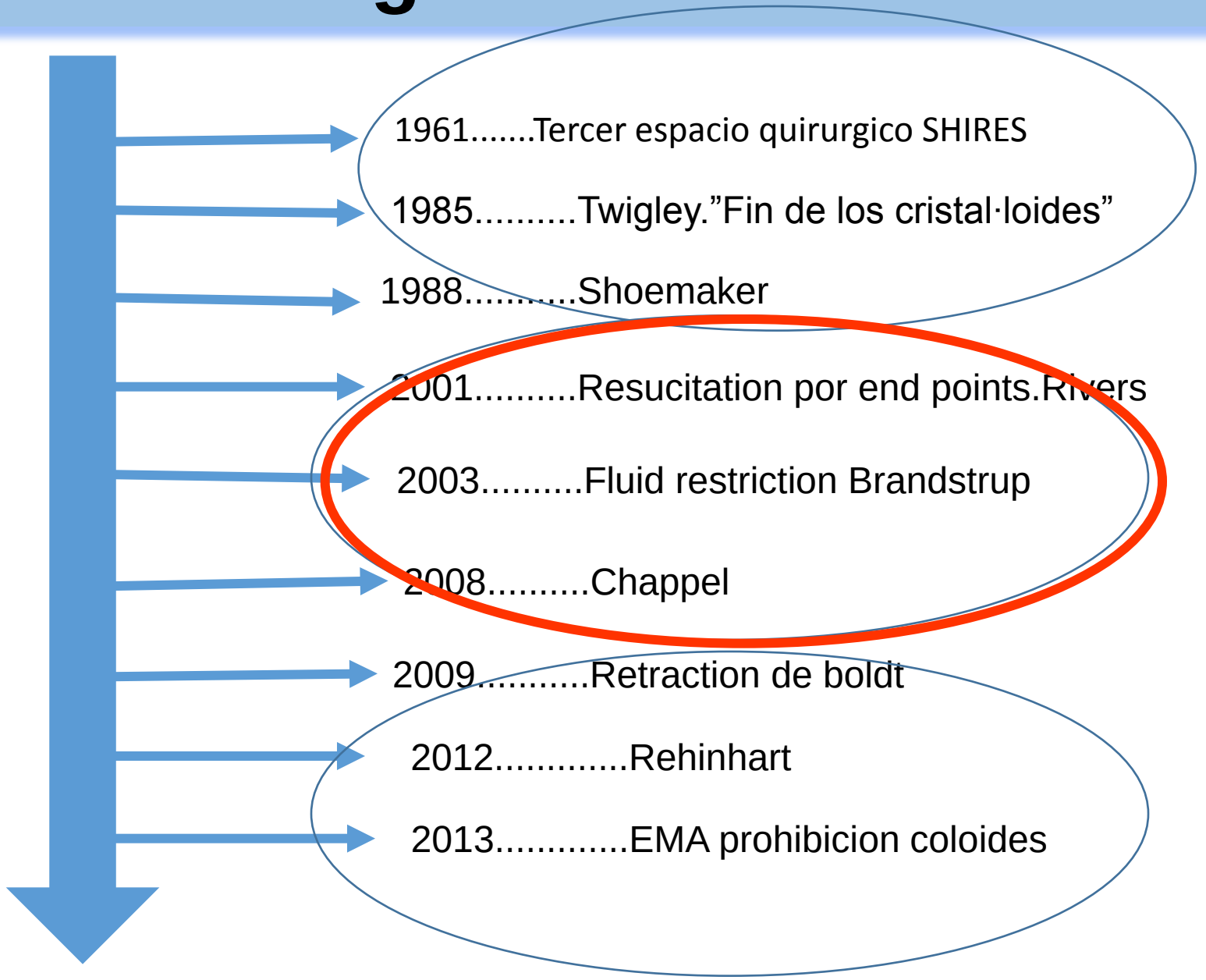

Cirugía
Patología asociada
Hidratación preoperatoria
Estado nutricional
Preparación intestinal
Anestesia/Bloqueo Neuroaxial
Morbilidad perioperatoria
Volemia óptima
Hipovolemia
Riesgo
Hipoperfusión
SRIS
Sepsis
FMO
Hipervolemia
Riesgo
Edema
Íleo
NVPO
Complicaciones Pulmonares
Consumo miocárdico
Normovolemia
Volemia Perioperatoria

Table 3 Studies in critically ill patients describing the association with fluid overload and worse outcome

Study	Design	Population	Exposures	Outcomes
Pediatric Studies				
Goldstein *et al*[35]	Retrospective	Pediatric critically ill starting CRRT	% FO	↑ % FO associated with ↑ mortality
Foland *et al*[60]	Retrospective	Pediatric critically ill starting CRRT	% FO	↑ % FO associated with ↑ organ dysfunction + mortality
Sutherland *et al*[31]	Retrospective	Pediatric critically ill starting CRRT	% FO	↑ % FO associated with ↑ mortality
Arikan *et al*[30]	Retrospective	Pediatric critically ill starting CRRT	% FO	↑ % FO associated with ↓ lung function
Adult Studies				
Payen *et al*[61]	Post-hoc prospective	Adult critically ill septic patients	FB	↑ FB associated with ↑ mortality
Murphy *et al*[62]	Retrospective	Adult critically ill ALI patients	AIFR + CLFM	↑ Survival for ↑ AIFR + ↑ CLFM
Bouchard *et al*[63]	Post-hoc prospective	Adult critically ill AKI patients	% FO > 10%	↑ FB associated with ↑ mortality
Wiedemann *et al*[36]	RCT	Adult critically ill with ALI	Conservative *vs* liberal fluid management strategy	↑ MV-free days; ↑ ICU-free days with conservative strategy
Fulop *et al*[64]	Retrospective	Adult critically ill starting CRRT	VRWG	↑ VRWG associated with ↑ mortality
Boyd *et al*[65]	Post-hoc analysis from VASST	Adult critically ill septic patients	Quartiles of FB + CVP at 12 h and 4 d	↑ FB at 12 h and 4 d associated with ↑ mortality; CVP < 8 at 12 h ↓ mortality
Grams *et al*[66]	Post-hoc FACCT	Adult critically ill with ALI + AKI	FB + diuretics	↑ FB associated with ↑ mortality
Heung *et al*[67]	Retrospective	Adult critically ill starting CRRT	% FO	↑ % FO associated with ↓ kidney recovery
Bellomo *et al*[68]	Post-hoc RENAL	Adult critically ill with AKI	FB	↑ FB associated with ↑ mortality

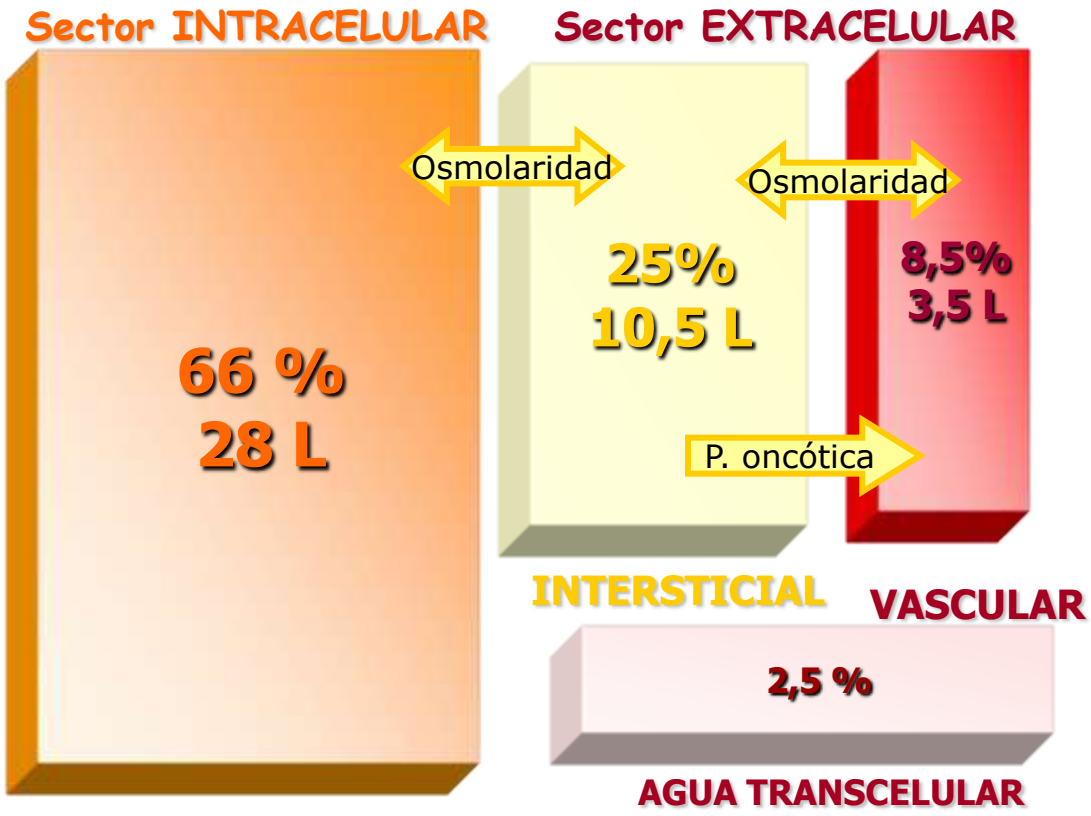
Adapted from Raghunathan *et al*[58]. ALI: Acute lung injury; AIFR: Adequate initial fluid resuscitation; CLFM: Conservative late fluid management; VRWG: Volume-related weight gain; AKI: Acute kidney injury; CVP: Central venous pressure; ICU: Intensive care unit; RCT: Randomized clinical trial.

Cronologia dels fets



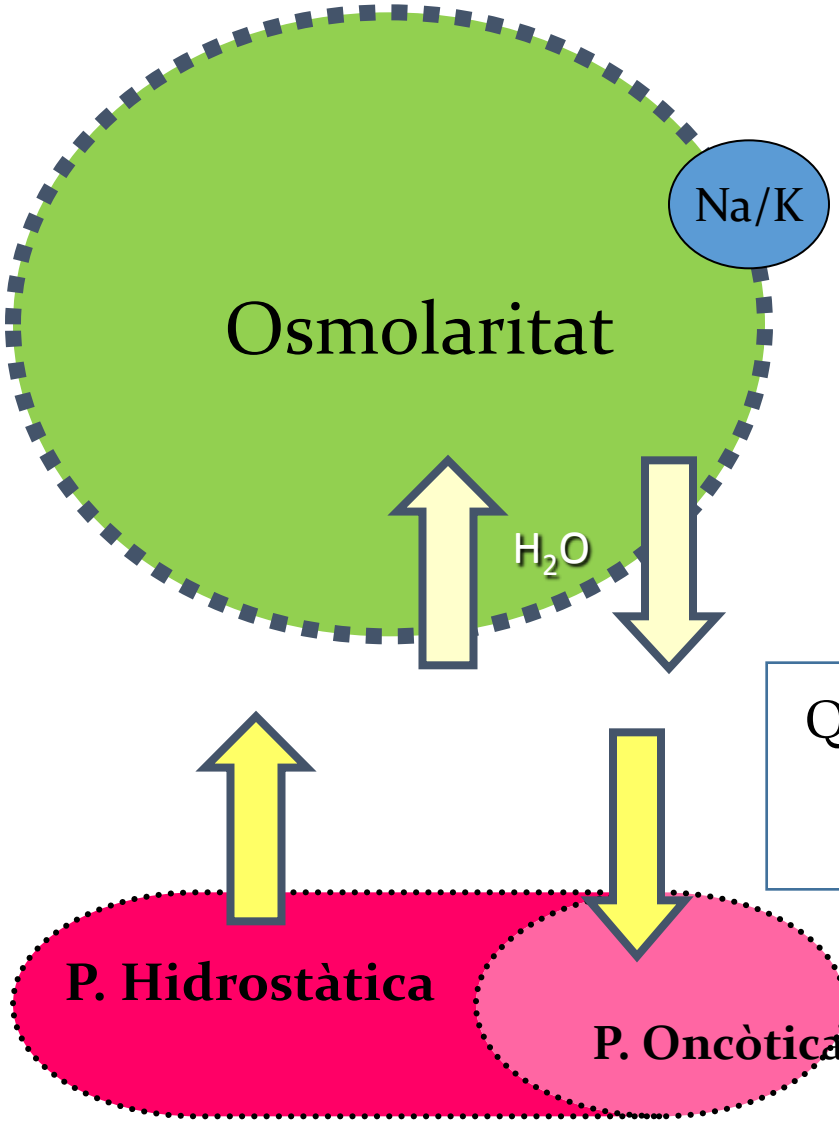
I ara que?

Distribució líquids del organisme



Peso Corporal: 70 Kg = 60%: 42 L H_2O

Moviments entre els compartiments

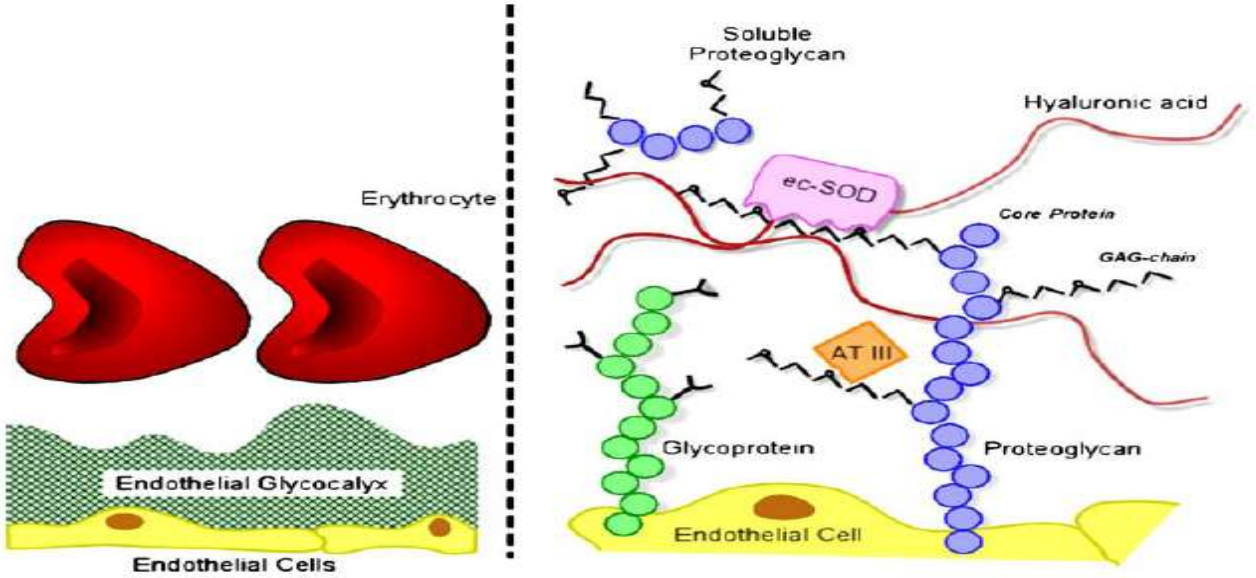


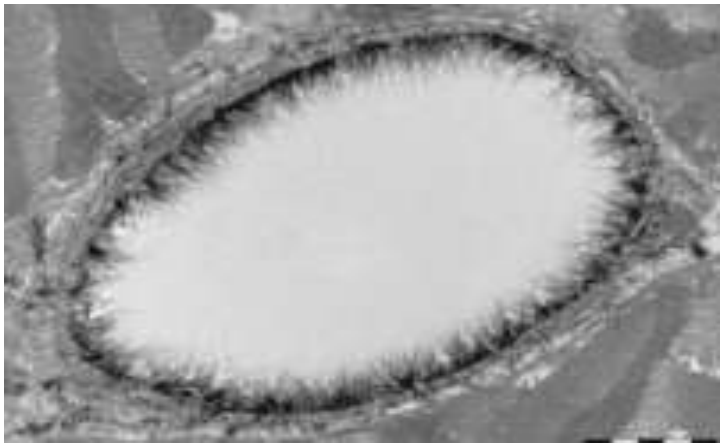
$$Qf = K[(PC-PI)-r\ (PosmC-PosmI)]$$

Llei d'Starling

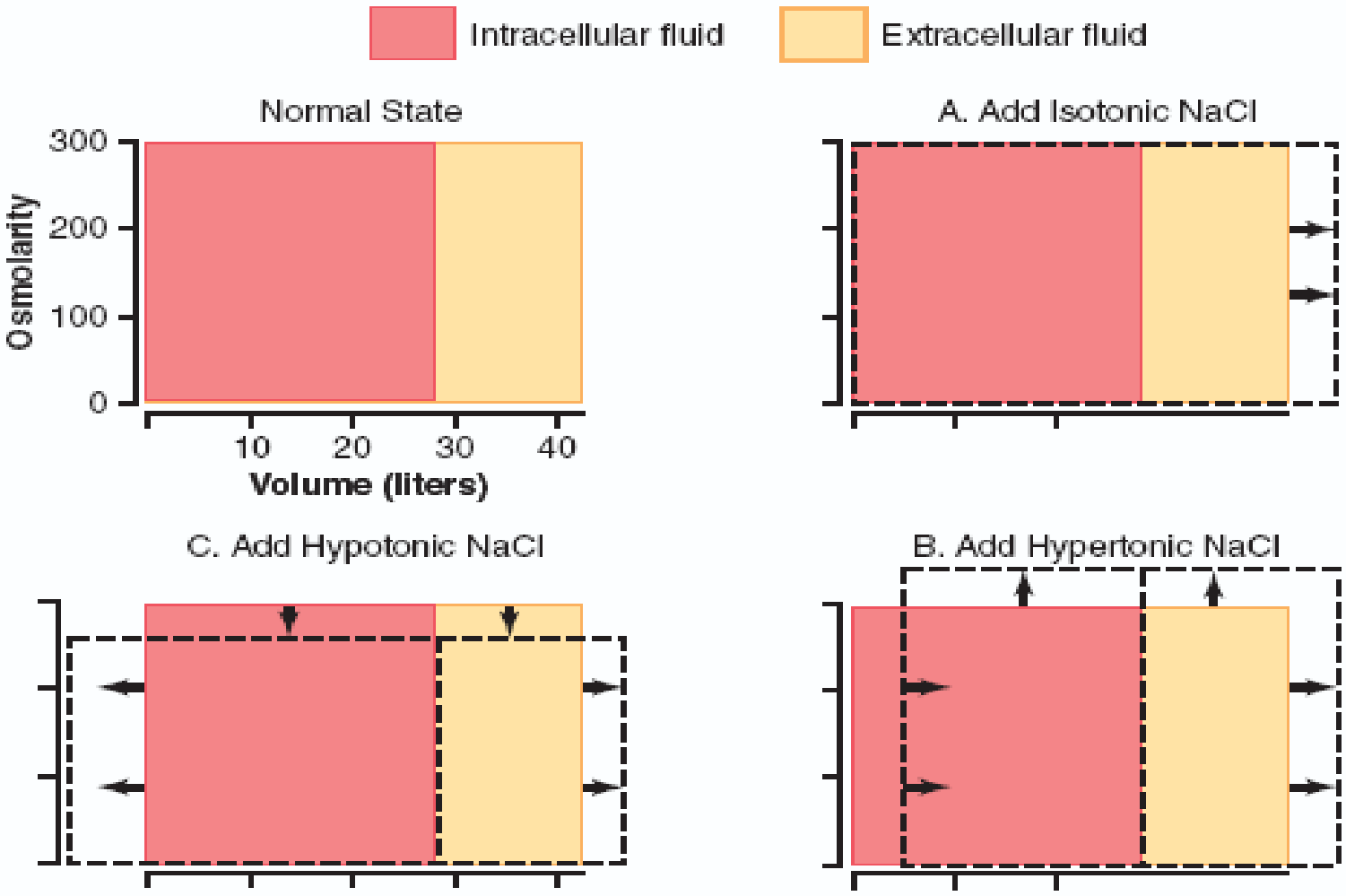
Estructura del Glycocàlix

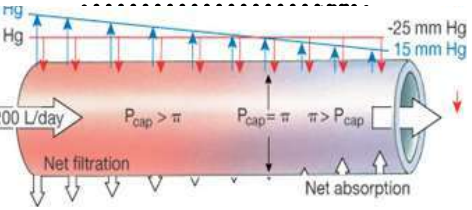
Pflugers Arch - Eur J Physiol (2007) 454:345–359





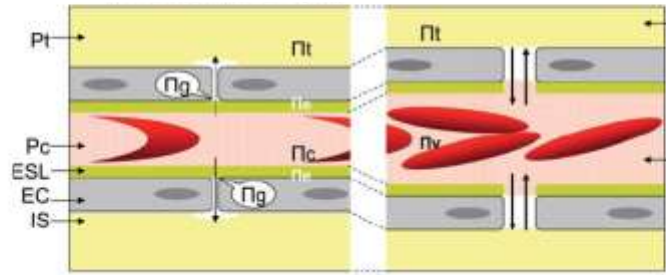
Moviments de líquids segons l'osmolaritat





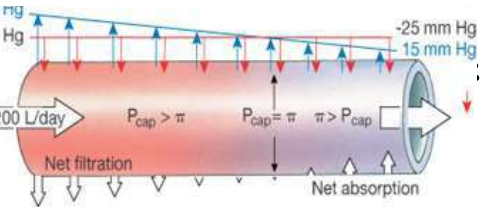
T. E. Woodcock[1*] and T. M. Woodcock

El volum intravascular està format pel volum plasmàtic i el volum cel·lular

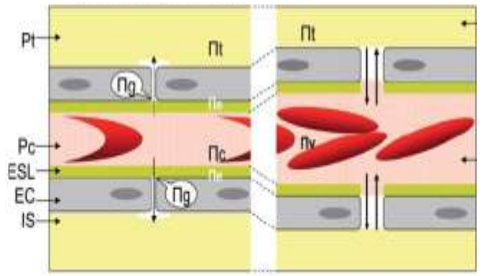


El volum intravascular està format pel volum del glycocàlix, el volum del plasma i el volum cel·lular

BJA Advance Access published January 29, 2012



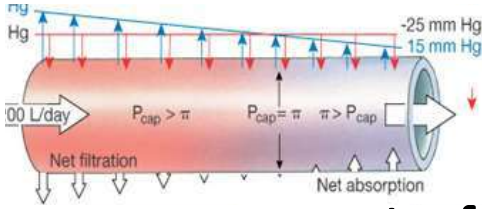
Les forces d'Starling són les diferències de pressió hidrostàtica transendotelial i la diferència de pressió oncòtica entre el plasma i el líquid intersticial



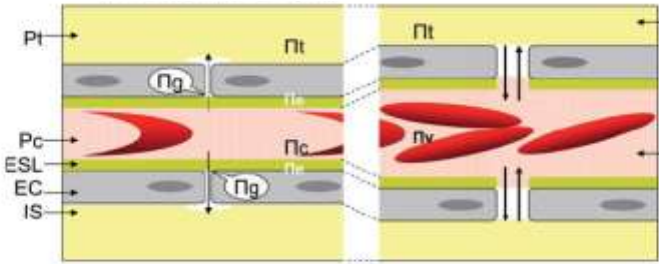
Les forces d'Starling són les diferències de pressió hidrostàtica entre el líquid intersticial i el plasmàtic i la diferència de pressió oncòtica entre el plasma i el "subglycocalix"

La pressió oncòtica del líquid intersticial no és determinant del filtrat capil·lar

BJA Advance Access published January 29, 2012

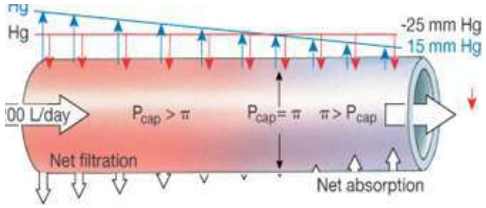


La fuita capil·lar es produeix sobretot en la part arterial del sistema vascular i s'absorbeix en la part venular.
Una petita part torna al sistema circulatori a través dels vasos limfàtics

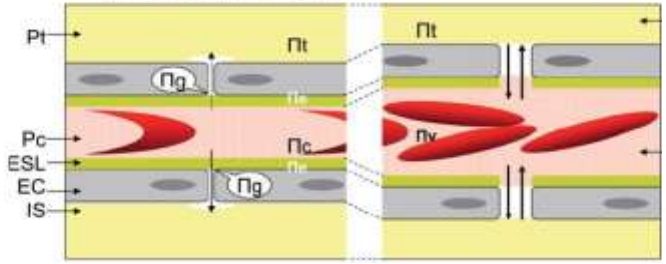


La fuita capil·lar és molt menor de la predita per l'antiga llei d'Starling.
La major part de l'absorció es fa a través del sistema limfàtic

BJA Advance Access published January 29, 2012

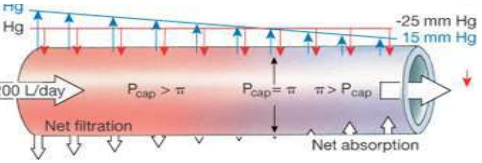


Augmentant la pressió oncòtica plasmàtica , podem augmentar la reabsorció del líquid intersticial



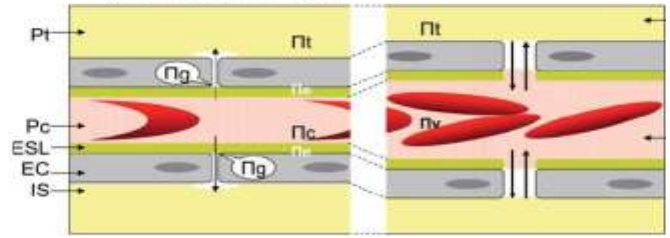
Augmentant la pressió oncòtica plasmàtica reduïm la fuita capil·lar, però no es provoca absorció

BJA Advance Access published January 29, 2012



T. E. Woodcock[1*] and T. M. Woodcock

Les solucions col·loïdals es distribueixen en l'espai intravascular i els cristal·loides en tot el volum extracel·lular



Inicialment els col·loides es distribueixen plasmàtic i els cristal·loides en l'intravascular.

A pressió capil·lar alta els col·loid en la pressió oncòtica del plasma, pero augmentant la pressió tant la fuita .

A pressió capil·lar alta la cristal·loides, augmenta la pressió capil·lar, però disminueix la p tica, per tant augmenta la fuita capil·lar molt més que la infusió de lum de col·loide.

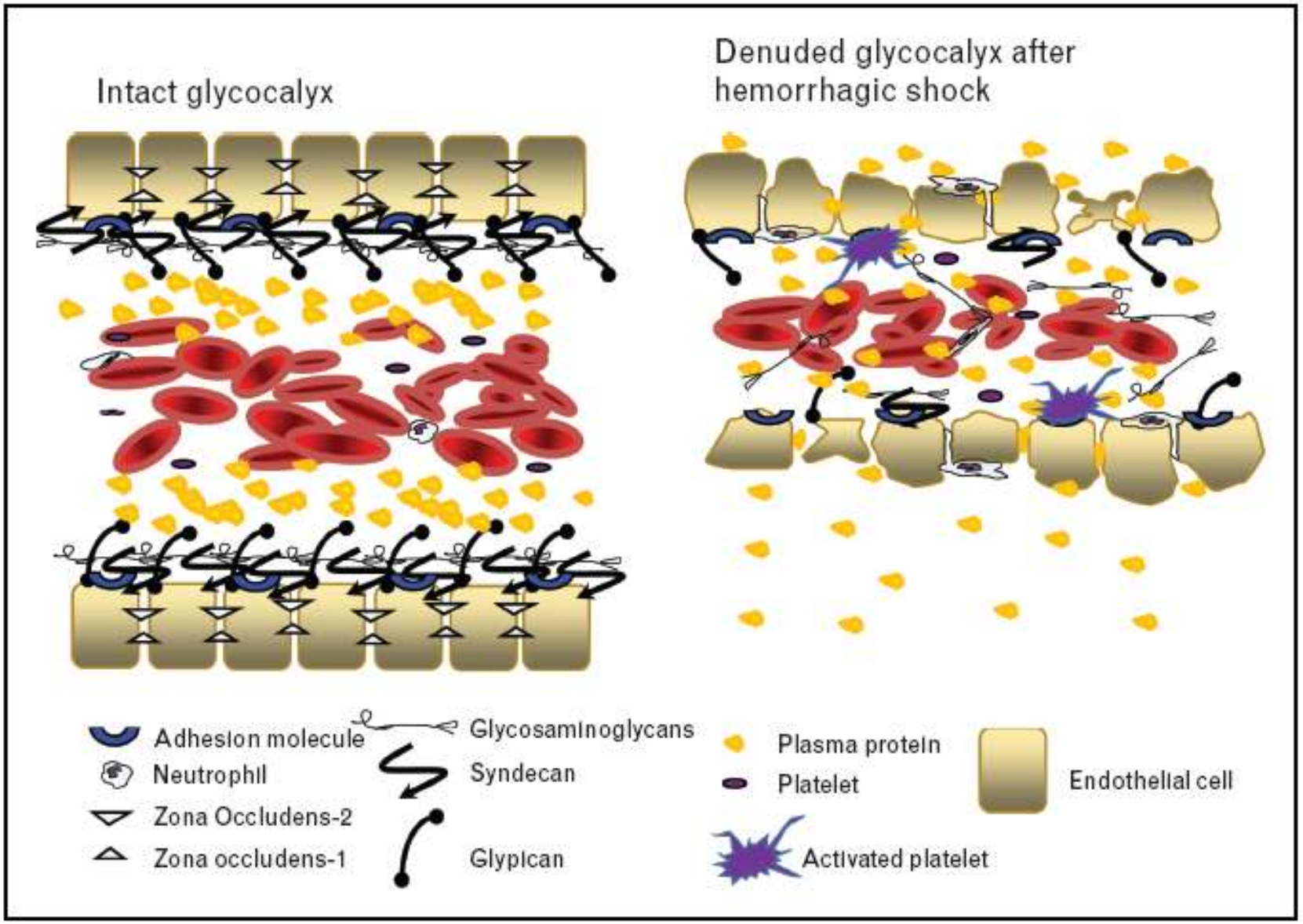
A pressions baixes la infusió de col·loides augmenta el volum plasmàtic i el de cristal·lo el volum intravascular, però el volum de filtració es manté casi nul en els dos casos

"Sensibilitat al context"

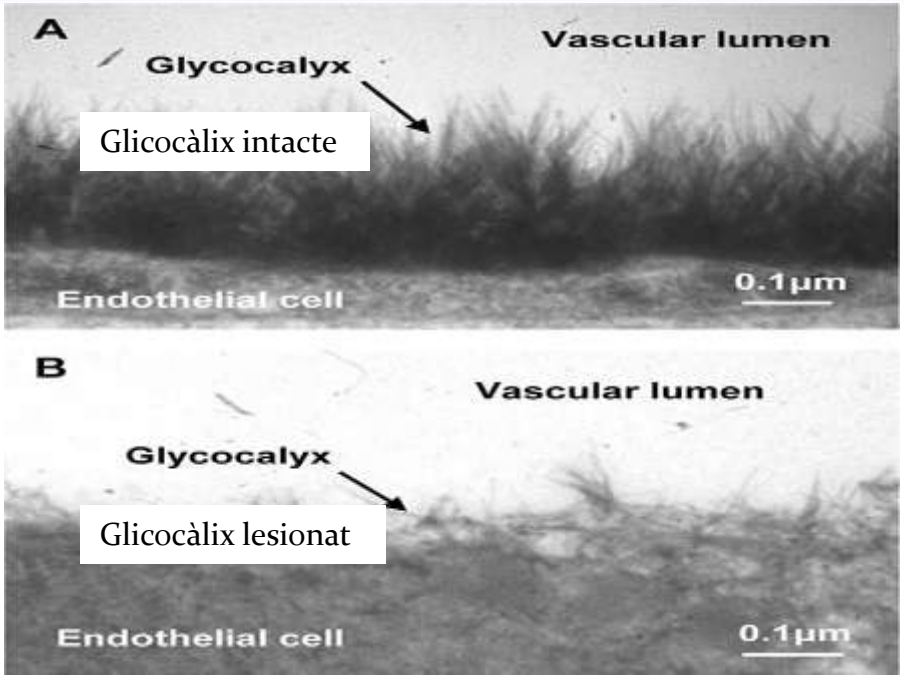
BJA Advance Access published January 29, 2012

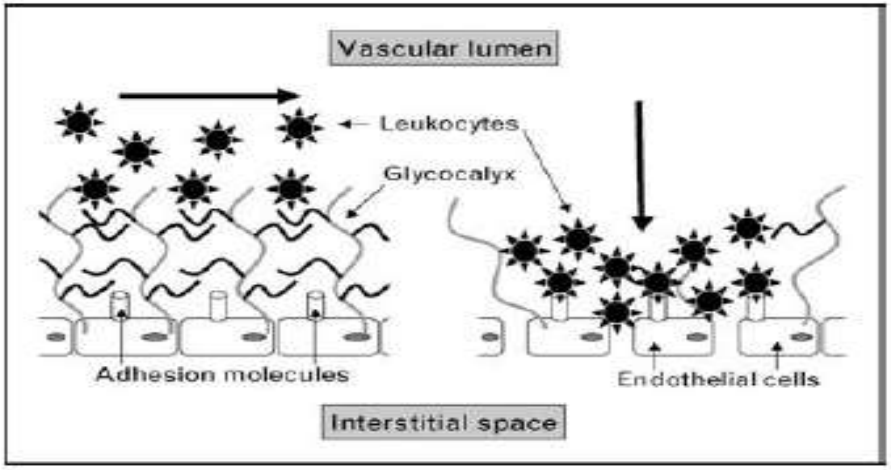
Inflammatory response to trauma: implications for coagulation and resuscitation

Curr Opin Anesthesiol 2014, 27:246–252



Lesió del Glycocàlix

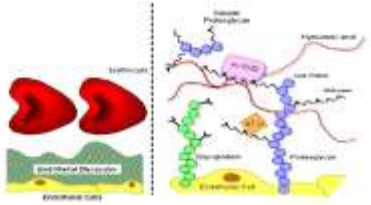




- Proteases
- TNF-α
- ANP (Hipervolemia)
- Isquèmia –reperfussió
- Estrès quirúrgic

Fuita capil·lar

Glicocàlyx y Llei d'Starling revisada

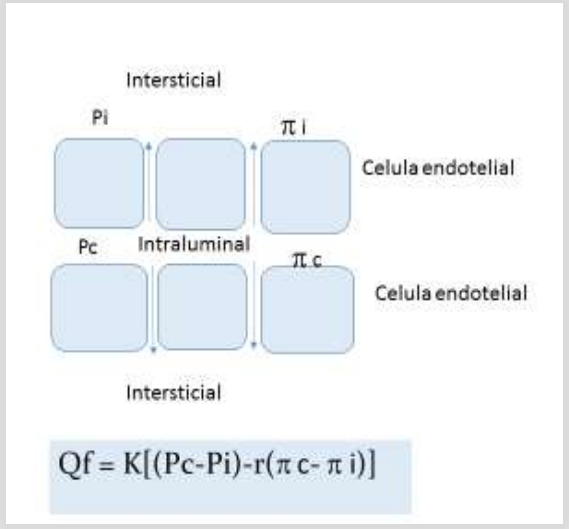


Fuites intravasculars tipus I

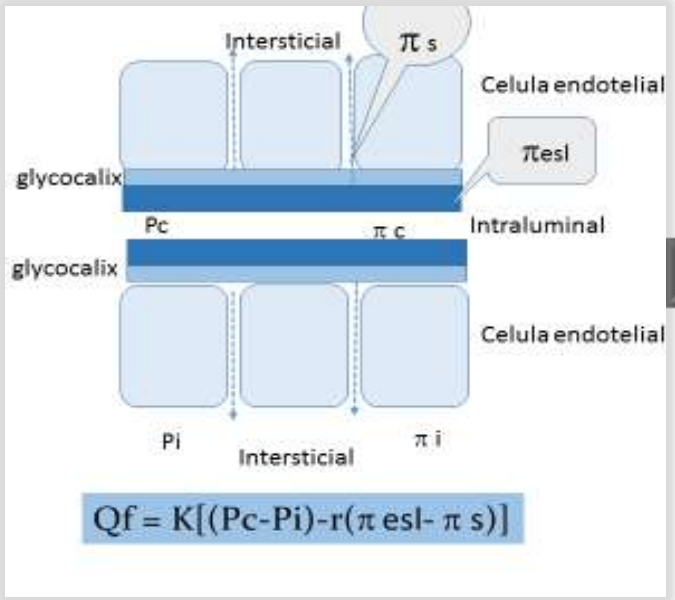
- Cinètica de líquids/electrolits
- Sense lesió de barrera
- Funció de baixa P. Oncòtica ó elevada P. Hidrostàtica

Fuites intravasculars tipus II

- Pèrdua de proteïnes
- Lesió de barrera
- Per stress neuroendocri/citokines.
- Per hipervolemia



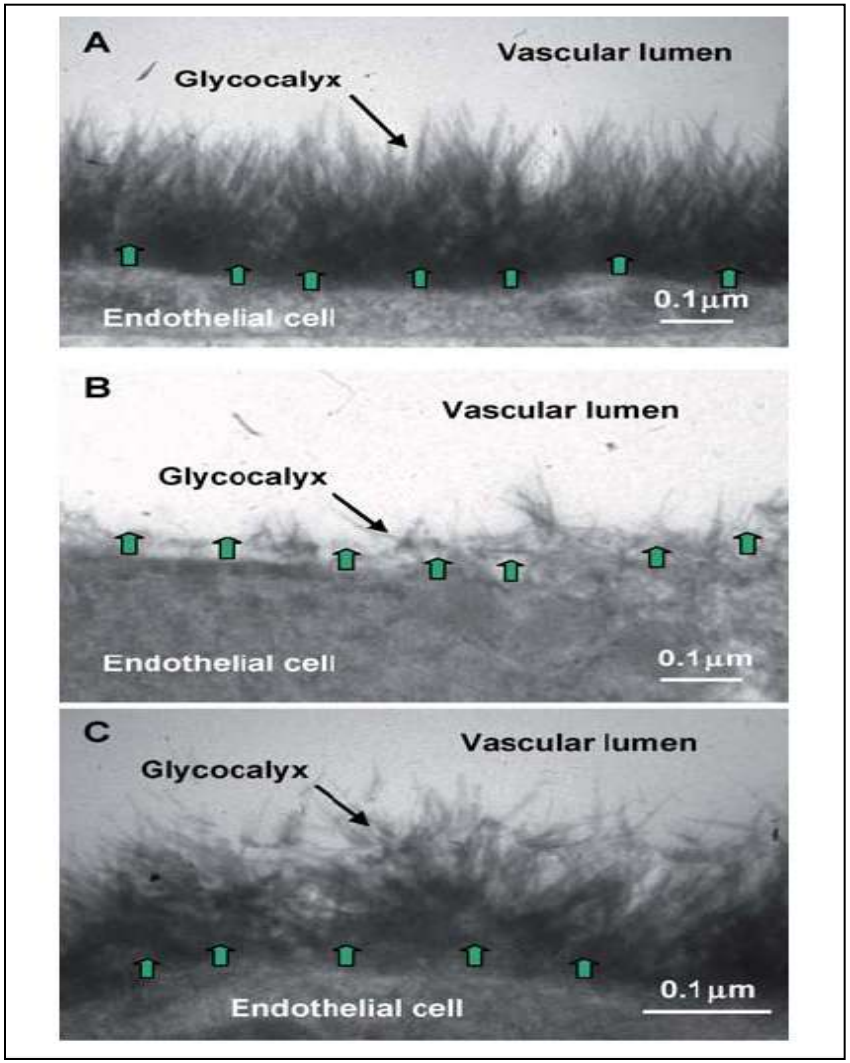
Tradicional



Revisada

Opcions terapèutiques glycocàlix

- N-acetilcisteina
- Antitrombina III
- Hidrocortisona
- Sevofluorane



Therapeutic strategies targeting the endothelial glycocalyx: acute deficits, but great potential†

Bernhard F. Becker[1]*, Daniel Chappell[2], Dirk Bruegger[2], Thorsten Annecke[1,2], and Matthias Jacob[2]

Damage of the endothelial glycocalyx, which ranges from 200 to 2000 nm in thickness, decreases vascular barrier function and leads to protein extravasation and tissue oedema, loss of nutritional blood flow, and an increase in platelet and leucocyte adhesion. Thus, its protection or the restoration of an already damaged glycocalyx seems to be a promising therapeutic target both in an acute critical care setting and in the treatment of chronic vascular disease. Drugs that can specifically increase the synthesis of glycocalyx components, refurbish it, or selectively prevent its enzymatic degradation do not seem to be available. Pharmacological blockers of radical production may be useful to diminish the oxygen radical stress on the glycocalyx. Tenable options are the application of hydrocortisone (inhibiting mast-cell degranulation), use of antithrombin III (lowering susceptibility to enzymatic attack), direct inhibition of the cytokine tumour necrosis factor-α, and avoidance of the liberation of natriuretic peptides (as in volume loading and heart surgery). Infusion of human plasma albumin (to maintain mechanical and chemical stability of the endothelial surface layer) seems the easiest treatment to implement.

Cardiovascular Research (2010) **87**, 300–310

Sevoflurane Reduces Leukocyte and Platelet Adhesion after Ischemia-Reperfusion by Protecting the Endothelial Glycocalyx

Daniel Chappell, M.D.,* Bernhard Heindl, M.D., Ph.D.,† Matthias Jacob, M.D.,* Thorsten Annecke, M.D.,‡ Congcong Chen, M.D.,§ Markus Rehm, M.D.,† Peter Conzen, M.D.,‖ Bernhard F. Becker, M.D., Ph.D.#

Anesthesiology, V 115 • No 3 September 2011

What We Already Know about This Topic

- The endothelial glycocalyx, composed of a variety of transmembrane and membrane-bound proteins, serves as barrier to excessive endothelial permeability, but the glycocalyx is disrupted by ischemia and reperfusion

What This Article Tells Us That Is New

- The volatile anesthetic sevoflurane stabilizes the endothelial glycocalyx and prevents postischemic adhesion of leukocytes and platelets, which may contribute to the cardioprotective effects of volatile anesthetics

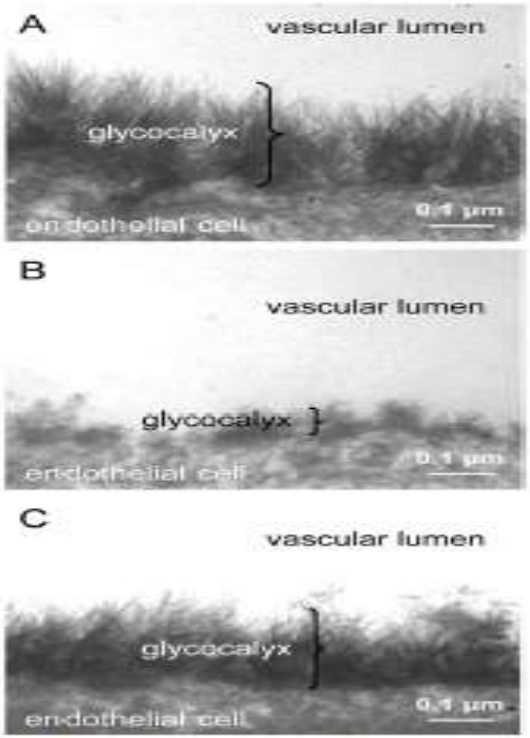
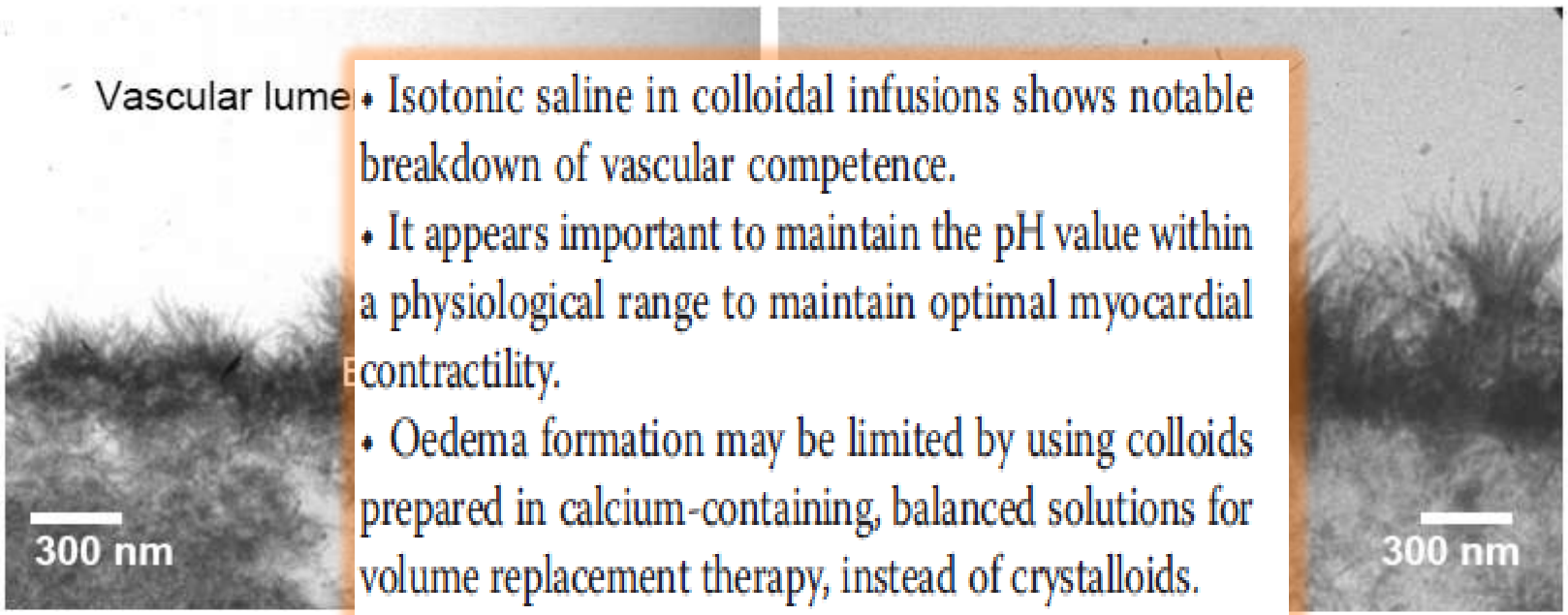


Fig. 2. Electron microscopic views of hearts stained to reveal the glycocalyx. (*A*) An intact glycocalyx after 25 min of nonischemic perfusion (group A). (*B*) A residual endothelial glycocalyx after 20 min of warm ischemia and 10 min consecutive reperfusion (group J). (*C*) The glycocalyx after pretreatment with 1 minimum alveolar concentration sevoflurane followed by 20 min of warm (37°C) no-flow ischemia and 10 min reperfusion (group L).

The impact of crystalloidal and colloidal infusion preparations on coronary vascular integrity, interstitial oedema and cardiac performance in isolated hearts

York A Zausig[1†], Daniel Chappell[2†], Bernhard F Becker[3], Daniel Potschka[1], Hendrik Busse[1], Kathrin Nixdorf[2], Diane Bitzinger[1], Barbara Jacob[2] and Matthias Jacob[2*]



- Isotonic saline in colloidal infusions shows notable breakdown of vascular competence.
- It appears important to maintain the pH value within a physiological range to maintain optimal myocardial contractility.
- Oedema formation may be limited by using colloids prepared in calcium-containing, balanced solutions for volume replacement therapy, instead of crystalloids.

Figure 2 Endothelial glycocalyx. Exemplary electron microscopy picture of an intact endothelial glycocalyx after perfusion under control conditions (*TF-Control*, left panel) and after intracoronary infusion of 6% hydroxyethyl starch (*TF-6% HES*, right panel).

Conclusions: It appears important to maintain the pH value within a physiological range to maintain optimal myocardial contractility. Using colloids prepared in calcium-containing, balanced solutions for volume replacement therapy may attenuate the breakdown of vascular barrier competence in the critically ill.

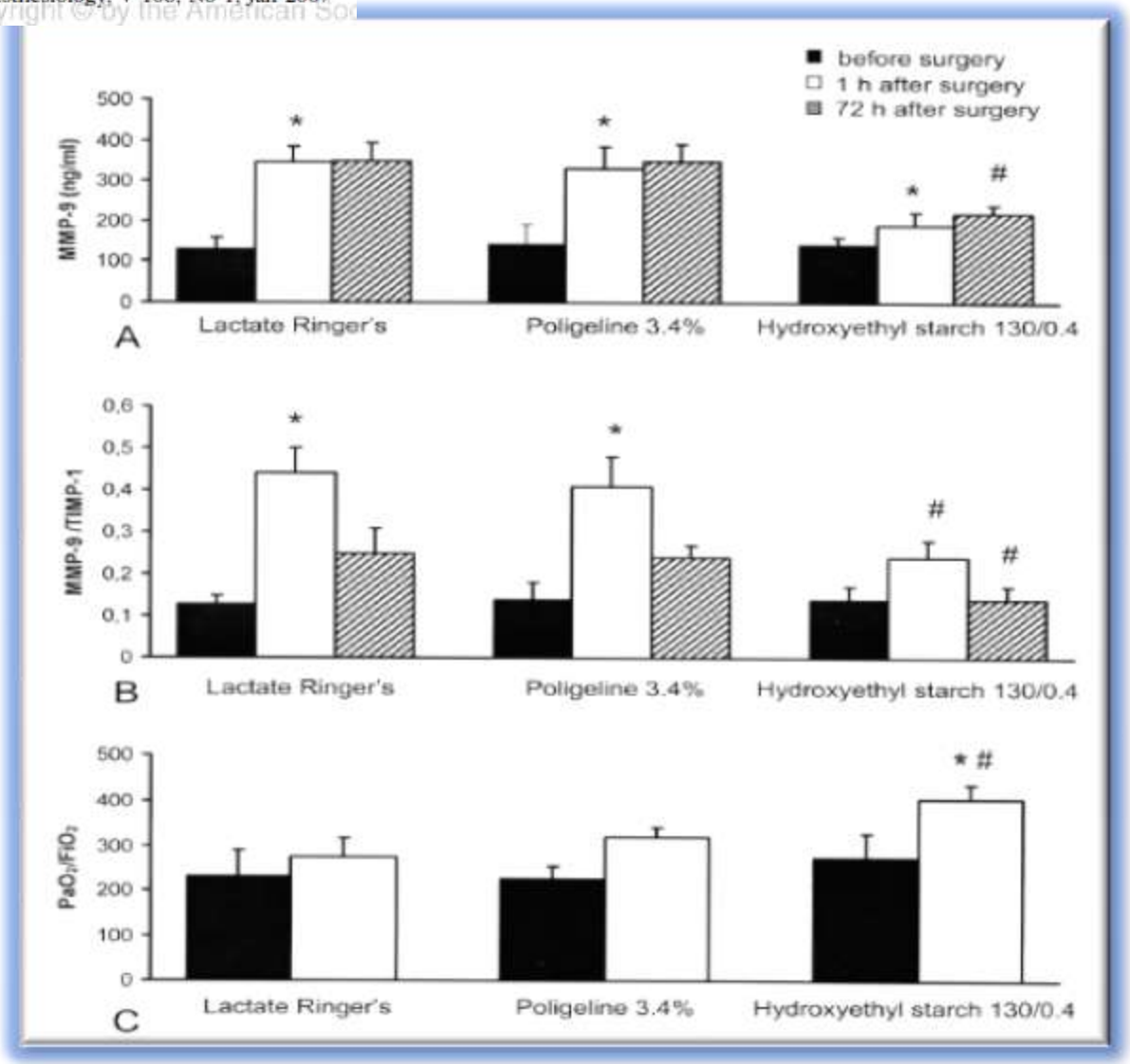
Zausig *et al. Critical Care* 2013, **17**:R203
http://ccforum.com/content/17/5/R203

Influence of Different Strategies of Volume Replacement on the Activity of Matrix Metalloproteinases

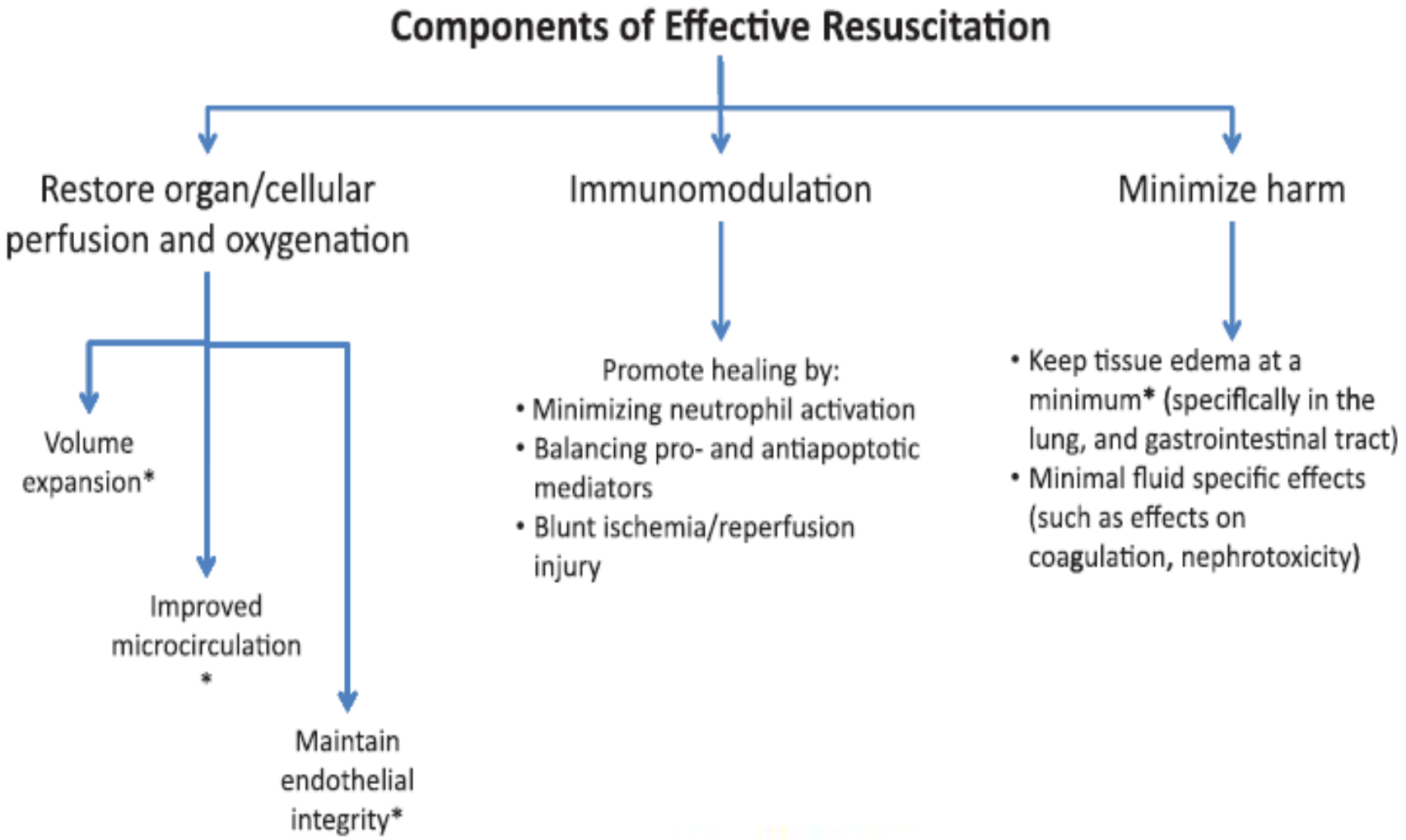
An In Vitro *and* In Vivo *Study*

Carlo A. Volta, M.D., Valentina Alvisi, M.D.,† Matilde Campi, M.D.,‡ Elisabetta Marangoni, M.D.,† Raffaele Alvisi, M.D.,§ Massimiliano Castellazzi, D.,‖ Enrico Fainardi, M.D., Ph.D.,# Maria C. Manfrinato, Ph.D.,** Franco Dallocchio, D.,†† Tiziana Bellini, D.‡‡*

Anesthesiology, V 106, No 1, Jan 2007



Objectius de la fluïdoteràpia operatòria



A. Bagchi and M. Eikermann Anesthesiology 2013; 118:244-7

Amb Què?

Cristal·loides :

66 % no participa de la volèmia
Acidosis hiperclorèmica
Hipotèrmia

1-2 ml/kg /hora + Reposició orina i altres pèrdues no hemàtiques i digestives

Col·loides:

Major poder expansor (100% en 6 hores)
Paper antiinflamatori: Protector del glycocalix

Des de l'inici de pèrdues hemàtiques i per càrregues si hipovolèmia

(Chappell 2008)

Farmacocinètica dels fluids

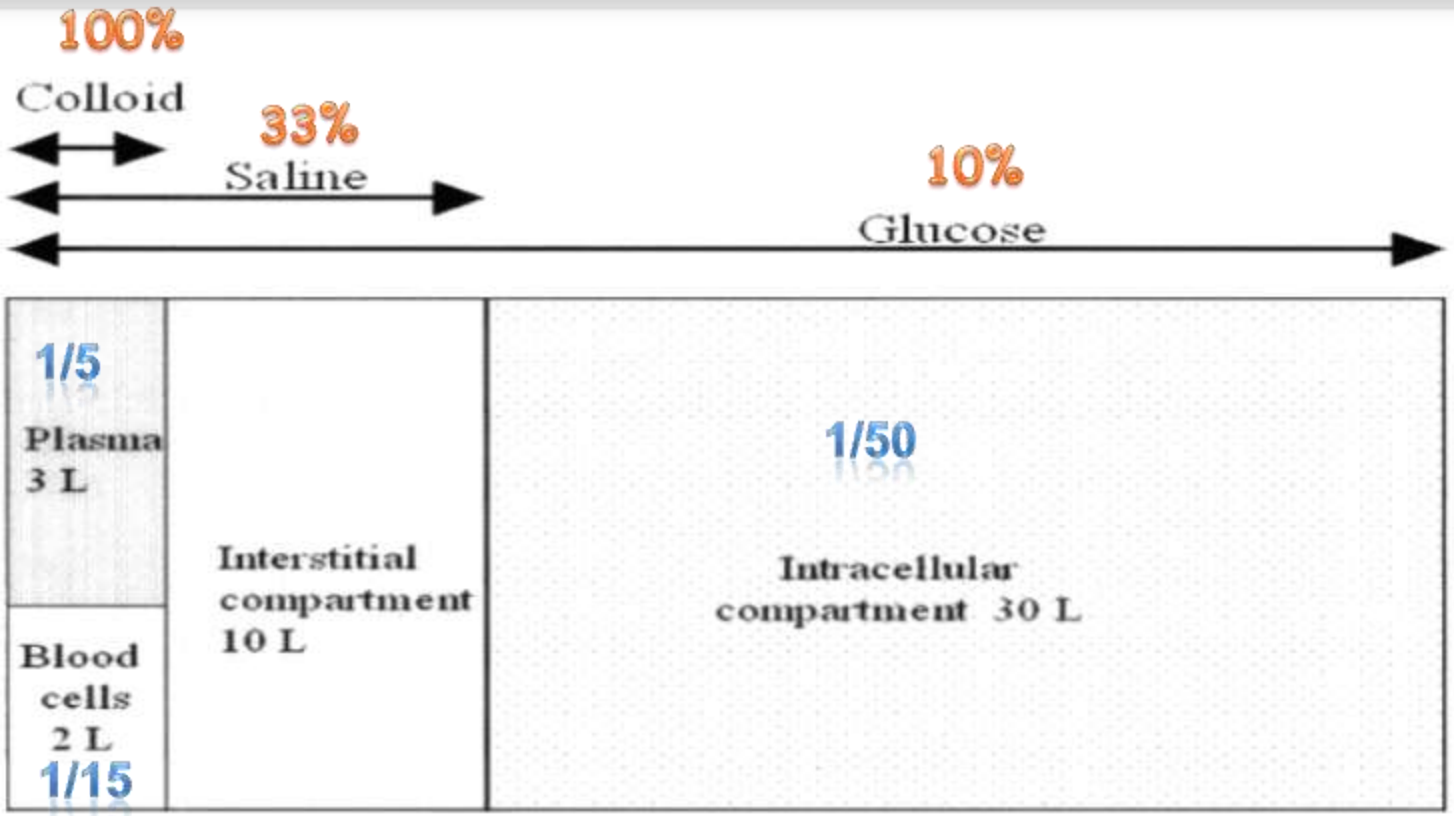
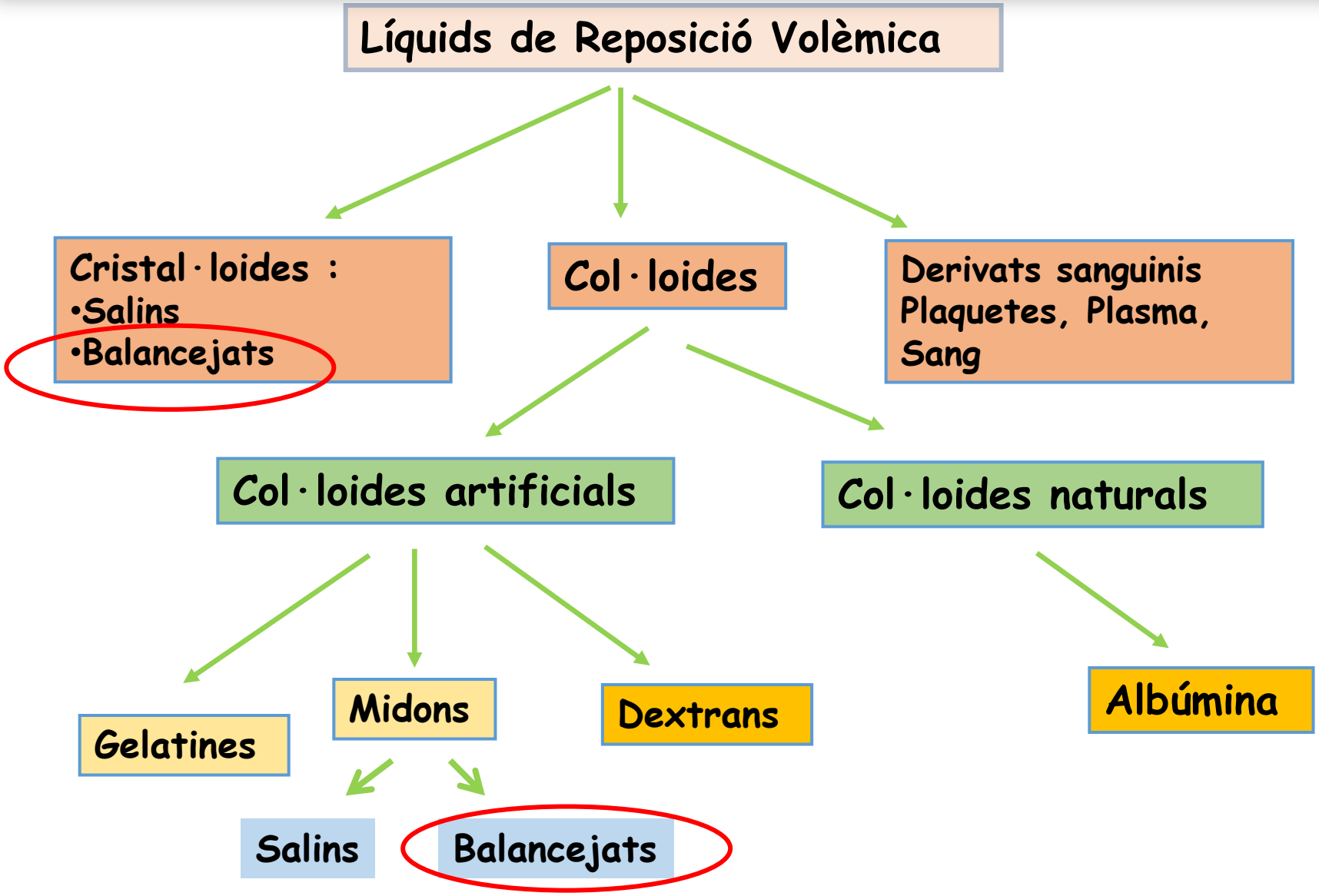


Figure 1. Model for volumes of distribution of isotonic colloid, saline, and glucose solutions.

$$\text{Plasma volume expansion} = \frac{\text{Volume infused}}{\text{Volume of distribution}}$$

Grocott, 2005

Classificació dels líquids per la Teràpia de RV



A Randomized, Controlled, Double-Blind Crossover Study on the Effects of 2-L Infusions of 0.9% Saline and Plasma-Lyte® 148 on Renal Blood Flow Velocity and Renal Cortical Tissue Perfusion in Healthy Volunteers

Abeed H. Chowdhury, BSc, MRCS, Eleanor F. Cox, PhD,† Susan T. Francis, PhD,† and Dileep N. Lobo, DM, FRCS, FACS**

Conclusions: This is the first human study to demonstrate that intravenous infusion of 0.9% saline results in reductions in renal blood flow velocity and renal cortical tissue perfusion. This has implications for intravenous fluid therapy in perioperative and critically ill patients. NCT01087853

(*Ann Surg* 2012;256:18–24)

OPEN

Should
of fluid
kidney

Dileep N. Lob

[1]Division of Gastr
Unit, Nottingham

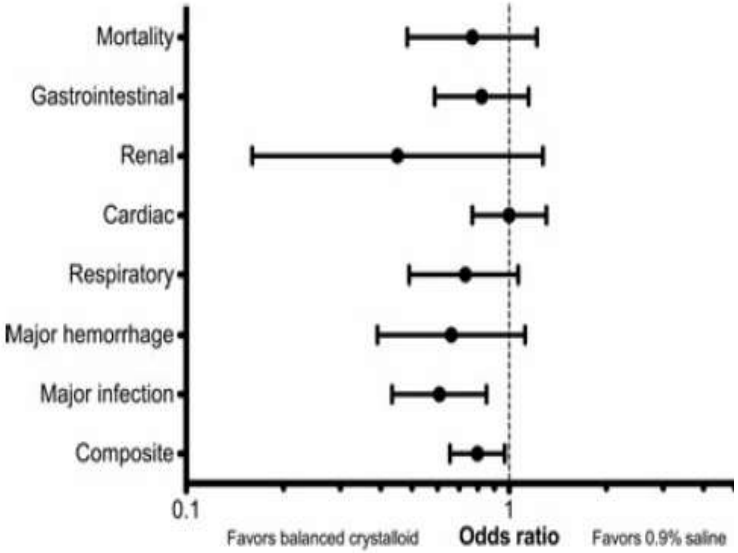
Metabolic	• Hyperchloremic acidosis • ↑Need for buffers to correct acidosis
Body water	• Possible damage to the endothelial glycocalyx • ↑Interstitial fluid volume leading to edema
Renal	• Renal edema and capsular stretch leading to intrarenal tissue hypertension • Renal vasoconstriction, ↓renal blood flow and renal tissue perfusion • ↓Glomerular filtration rate, urine volume, and sodium excretion
Gastrointestinal	• Gastrointestinal edema, intestinal stretch • Ileus, impaired anastomotic healing
Hematological	• ↑Intraoperative blood loss • ↑Need for blood product transfusion
Clinical outcomes	• ↑Postoperative complications • ↑Mortality • ↑Incidence of acute kidney injury and need for renal replacement therapy

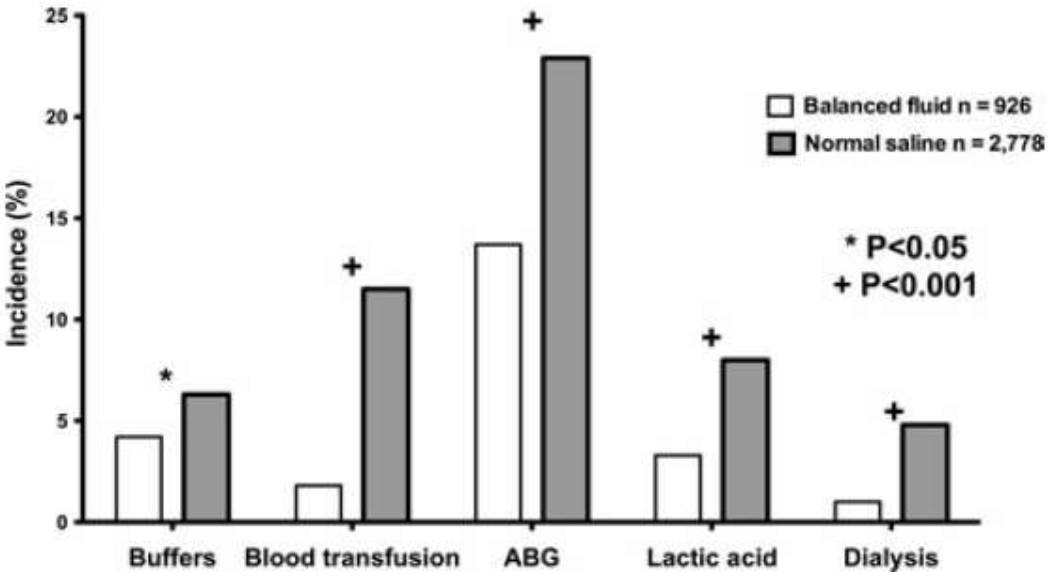
Figure 3 | Adverse events related to intravenous therapy with 0.9% saline when compared with balanced crystalloids. The evidence has been collected from animal studies, healthy volunteer studies, small randomized clinical trials, and large patient cohort studies, and cannot be presently regarded as Grade A.

Major Complications, Mortality, and Resource Utilization After Open Abdominal Surgery

0.9% Saline Compared to Plasma-Lyte

Andrew D. Shaw, MB, FRCA, FCCM, Sean M. Bagshaw, MD,† Stuart L. Goldstein, MD,‡ Lynette A. Scherer, MD,§ Michael Duan, MS,‖ Carol R. Schermer, MD,¶ and John A. Kellum, MD#*





Annals of Surgery • Volume 255, Number 5, May 2012

The intravascular volume effect of Ringer's lactate is below 20%: a prospective study in humans

Matthias Jacob[1*†], Daniel Chappell[1†], Klaus Hofmann-Kiefer[1], Tobias Helfen[1], Anna Schuelke[1], Barbara Jacob[1], Rehm[1]

Jacob *et al. Critical Care* 2012,

Conclusions: Substitution of isolated intravascular deficits in cardiopulmonary healthy adults with the three-fold amount of Ringer's lactate impedes maintenance of intravascular normovolemia. The main side effect was an impressive interstitial fluid accumulation, which was partly restored by the intravenous infusion of 20% human albumin. We recommend to substitute the five-fold amount of crystalloids or to use an isooncotic preparation in the face of acute bleeding in patients where edema prevention might be advantageous.

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.....quin col·loide?

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Colloid solutions for fluid resuscitation (Review)

Bunn F, Trivedi D

Authors' conclusions

From this review, there is no evidence that one colloid solution is more effective or safe than any other, although the confidence intervals are wide and do not exclude clinically significant differences between colloids. Larger trials of fluid therapy are needed if clinically significant differences in mortality are to be detected or excluded.

Hydroxyethyl starch (HES) versus other fluid therapies: effects on kidney function (Review)

Mutter TC, Ruth CA, Dart AB

Authors' conclusions

The current evidence suggests that all HES products increase the risk in AKI and RRT in all patient populations and a safe volume of any HES solution has yet to be determined. In most clinical situations it is likely that these risks outweigh any benefits, and alternate volume replacement therapies should be used in place of HES products.

Pharmacovigilance Risk Assessment Committee (PRAC)

EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

14 June 2013
EMA/349341/2013

PRAC recommends suspending marketing authorisations for infusion solutions containing hydroxyethyl-starch

The NEW ENGLAND JOURNAL of MEDICINE

N ENGL J MED 358;2 www.NEJM.ORG JANUARY 10, 2008

GINAL ARTICLE

Intensive Insulin Therapy and Pentastarch Resuscitation in Severe Sepsis

Frank M. Brunkhorst, M.D., Christoph Engel, M.D., Frank Bloos, M.D., Ph.D., Andreas Meier-Hellmann, M.D., Max Ragaller, M.D., Norbert Weiler, M.D., Onnen Moerer, M.D., Matthias Gruendling, M.D., Michael Oppert, M.D., Stefan Grond, M.D., Derk Olthoff, M.D., Ulrich Jaschinski, M.D., Stefan John, M.D., Rolf Rossaint, M.D., Tobias Welte, M.D., Martin Schaefer, M.D., Peter Kern, M.D., Evelyn Kuhnt, M.Sc., Michael Kiehntopf, M.D., Christiane Hartog, M.D., Charles Natanson, M.D., Markus Loeffler, M.D., Ph.D., and Konrad Reinhart, M.D., for the German Competence Network Sepsis (SepNet)

NEJM.ORG JULY 12, 2012

ORIGINAL ARTICLE

Hydroxyethyl Starch 130/0.42 versus Ringer's Acetate in Severe Sepsis

Anders Perner, M.D., Ph.D., Nicolai Haase, M.D., Anne B. Guttormsen, M.D., Ph.D., Jyrki Tenhunen, M.D., Ph.D., Gudmundur Klemenzson, M.D., Anders Åneman, M.D., Ph.D., Kristian R. Madsen, M.D., Morten H. Møller, M.D., Ph.D., Jeanie M. Elkjær, M.D., Lone M. Poulsen, M.D., Asger Bendtsen, M.D., M.P.H., Robert Winding, M.D., Morten Steensen, M.D., Pawel Berezowicz, M.D., Ph.D., Peter Søe-Jensen, M.D., Morten Bestle, M.D., Ph.D., Kristian Strand, M.D., Ph.D., Jørgen Wiis, M.D., Jonathan O. White, M.D., Klaus I. Thornberg, M.D., Lars Quist, M.D.,

The NEW ENGLAND JOURNAL of MEDICINE

N Engl J Med 2012.

ORIGINAL ARTICLE

Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

John A. Myburgh, M.D., Ph.D., Simon Finfer, M.D., Rinaldo Bellomo, M.D., Laurent Billot, M.Sc., Alan Cass, M.D., Ph.D., David Gattas, M.D., Parisa Glass, Ph.D., Jeffrey Lipman, M.D., Bette Liu, Ph.D., Colin McArthur, M.D., Shay McGuinness, M.D., Dorrilyn Rajbhandari, R.N., Colman B. Taylor, M.N.D., and Steven A.R. Webb, M.D., Ph.D., for the CHEST Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group*

British Journal of Anaesthesia **107** (5): 693–702 (2011)
Advance Access publication 19 August 2011 · doi:10.1093/bja/aer229

BJA

Resuscitation with hydroxyethyl starch improves renal function and lactate clearance in penetrating trauma in a randomized controlled study: the FIRST trial (Fluids in Resuscitation of Severe Trauma)

M. F. M. James [1*], W. L. Michell [2], I. A. Joubert [1], A. J. Nicol [2], P. H. Navsaria [2] and R. S. Gillespie [1]

[1] Department of Anaesthesia and [2] Department of Surgery, Groote Schuur Hospital and Faculty of Health Sciences, University of Cape Town, Anzio Road, Observatory, Cape Town, Western Cape 7925, South Africa

* Corresponding author. E-mail: mike.james@uct.ac.za

Guidet *et al. Critical Care* 2012,

Assessment of hemodynamic efficacy and safety of 6% hydroxyethylstarch 130/0.4 vs. 0.9% NaCl fluid replacement in patients with severe sepsis: The CRYSTMAS study

Bertrand Guidet[1,2,3*], Olivier Martinet[4], Thierry Boulain[5], Francois Philippart[6,7], Jean François Poussel[8], Julien Maizel[9], Xavier Forceville[10], Marc Feissel[11], Michel Hasselmann[4], Alexandra Heininger[12] and Hugo Van Aken[13]

JAMA November 6, 2013 Volume 310, Number 17

Effects of Fluid Resuscitation With Colloids vs Crystalloids on Mortality in Critically Ill Patients Presenting With Hypovolemic Shock

The CRISTAL Randomized Trial

Djillali Annane, MD, PhD; Shidasp Siami, MD; Samir Jaber, MD, PhD; Claude Martin, MD, PhD; Souheil Elatrous, MD; Adrien Descorps Declère, MD; Jean Charles Preiser, MD; Hervé Outin, MD; Gilles Troché, MD; Claire Charpentier, MD; Jean Louis Trouillet, MD; Antoine Kimmoun, MD; Xavier Forceville, MD, PhD; Michael Darmon, MD; Olivier Lesur, MD, PhD; Jean Reignier, MD; Fékri Abroug, MD; Philippe Berger, MD; Christophe Clec'h, MD, PhD; Joël Cousson, MD; Laure Thibault, MD; Sylvie Chevret, MD, PhD; for the CRISTAL Investigators

Pharmacovigilance Risk Assessment Committee (PRAC)

EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

25 October 2013
EMA/640658/2013

Hydroxyethyl-starch solutions (HES) should no longer be used in patients with sepsis or burn injuries or in critically ill patients – CMDh endorses PRAC recommendations

HES will be available in restricted patient populations

...The Committee concluded that there was clear evidence for an increased risk of kidney injury and mortality in critically ill and septic patients, and that therefore HES should no longer be used in these patients. However the PRAC agreed that **HES could continue to be used in patients with hypovolaemia caused by acute blood loss** where treatment with alternative infusions solutions known as 'crystalloids' alone are not considered to be sufficient.

Safety of Modern Starches Used During Surgery

Philippe Van Der Linden, MD, PhD,* Michael James, MB ChB, PhD, FRCA, FCA(SA),‡ Michael Mythen, MD FRCA,‡§‖ and Richard B. Weiskopf, MD¶

Various hydroxyethyl starch (HES) preparations have been used for decades to augment blood volume. There has been concern recently regarding possible adverse outcomes when using HES in the intensive care setting, especially in patients with septic shock. However, the pharmacokinetic and pharmacodynamic properties of HES preparations depend on their chemical composition and source material. Thus, different clinical conditions could result in differing effectiveness and safety for these preparations. Consequently, we assessed the safety of tetrastarches when used during surgery, using a formal search, that yielded 59 primary full publications of studies that met a priori inclusion criteria and randomly allocated 4529 patients with 2139 patients treated with tetrastarch compared with 2390 patients treated with a comparator. There were no indications that the use of tetrastarches during surgery induces adverse renal effects as assessed by change or absolute concentrations of serum creatinine or need for renal replacement therapy (39 trials, 3389 patients), increased blood loss (38 trials, 3280 patients), allogeneic erythrocyte transfusion (20 trials, 2151 patients; odds ratio for HES transfusion 0.73 [95% confidence interval = 0.61–0.87], $P = 0.0005$), or increased mortality (odds ratio for HES mortality = 0.51 [0.24–1.05], $P = 0.079$). (Anesth Analg 2012;XX:XX–XX)

Effect of Waxy Maize-derived Hydroxyethyl Starch 130/0.4 on Renal Function in Surgical Patients

Claude Martin, M.D.,* Matthias Jacob, M.D.,† Eric Vicaut, M.D.,‡ Bertrand Guidet, M.D.,§ Hugo Van Aken, M.D., Ph.D.,‖ Andrea Kurz, M.D.#

Anesthesiology, V 118 • No 2 February 2013

What We Already Know about This Topic

- The use of hydroxyethyl starches has been associated with nephrotoxicity and increase in mortality in the critically ill
- The renal safety of modern hydroxyethyl starches 130/0.40 in nonseptic surgical patients remains unclear

What This Article Tells Us That Is New

- In a meta-analysis of 17 randomized studies (n = 1,230) evaluating renal safety of waxy maize-derived hydroxyethyl starches 130/0.40 in surgical patients no evidence for renal dysfunction was observed

Balanced crystalloid compared with balanced colloid solution using a goal-directed haemodynamic algorithm

A. Feldheiser[1], V. Pavlova[1], T. Bonomo[3], A. Jones[1], C. Fotopoulou[2], J. Sehouli[2], K.-D. Wernecke[4] and C. Spies[1*]

Methods. In a double-blind pilot study, we randomly assigned 50 patients with primary ovarian cancer undergoing cytoreductive surgery to receive either balanced crystalloid or balanced starch (HES, 130/0.4, 6%) solutions up to the dose limit (50 ml kg^{-1}). Fluids were administered to optimize stroke volume measured by oesophageal Doppler within a goal-directed haemodynamic algorithm.

Results. Baseline subject characteristics were similar in both groups. The balanced HES solution maintained stroke volume ($P=0.012$) better with administration of less fluid. Subjects in the colloid group reached the dose limits of the study medication less frequently (92% *vs* 62%, $P=0.036$) and later (2:26 *vs* 3:33 h, $P=0.006$) and also required less transfusion of fresh-frozen plasma units (6.0 *vs* 3.5 units, $P=0.035$) compared with the crystalloid group. Intra- and postoperative urine output and perioperative plasma levels of creatinine and neutrophil gelatinase-associated lipocalin as renal injury marker were similar in both groups. No differences in the length of intensive care unit and hospital stay were found.

Conclusions. Using a goal-directed haemodynamic algorithm to optimize stroke volume, a balanced HES solution is associated with better haemodynamic stability and reduced need for fresh-frozen plasma. There were no signs of renal impairment by colloid solutions when fluid administration is targeted to optimize cardiac preload.

British Journal of Anaesthesia **110** (2): 231–40 (2013)

British Journal of Anaesthesia 107 (5): 693–702 (2011)
Advance Access publication 19 August 2011 · doi:10.1093/bja/aer229

BJA

Resuscitation with hydroxyethyl starch improves renal function and lactate clearance in penetrating trauma in a randomized controlled study: the FIRST trial (Fluids in Resuscitation of Severe Trauma)

M. F. M. James [1]*, W. L. Michell [2], I. A. Joubert [1], A. J. Nicol [2], P. H. Navsaria [2] and R. S. Gillespie [1]

[1] Department of Anaesthesia and [2] Department of Surgery, Groote Schuur Hospital and Faculty of Health Sciences, University of Cape Town, Anzio Road, Observatory, Cape Town, Western Cape 7925, South Africa

* Corresponding author. E-mail: mike.james@u

Editor's key points

- Opinions are divided concerning resuscitation fluids in trauma.
- This double-blind randomized controlled trial compared resuscitation with isotonic hydroxyethyl starch (HES 130/0.4) or 0.9% saline in trauma patients.
- Biochemical markers of resuscitation and renal function were better in those who received HES 130/0.4 after penetrating trauma.
- Study outcomes were similar after blunt trauma, although numbers in these subgroups were modest.

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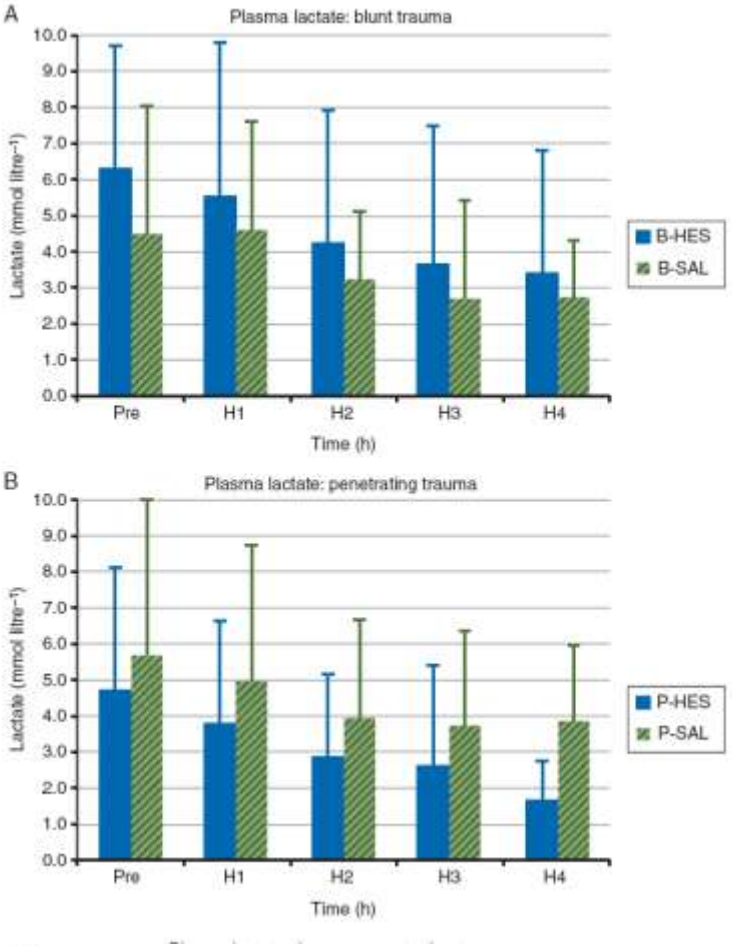

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trauma ($n=42$), there
ired significantly more
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erity score 29.5 *vs* 18;
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S group (16% *vs* 0%;
ion scores were lower
erences were seen in

lactate clearance and
blunt trauma.

Initial assessment on the impact of crystalloids *versus* colloids during damage control resuscitation

Chrissy Guidry, DO,[a,b] *Elizabeth Gleeson, MD, MPH,*[a,c] *Eric R. Simms, MD,*[a] *Lance Stuke, MD, MPH,*[d] *Peter Meade, MD, MPH,*[a] *Norman E. McSwain Jr, MD,*[a] *and Juan C. Duchesne, MD*[a,*]

[a] Department of General Surgery, Tulane University School of Medicine, New Orleans, Louisiana
[b] Department of General Surgery, Akron General Medical Center, Akron, Ohio
[c] Department of General Surgery, Drexel University College of Medicine, Philadelphia, Pennsylvania
[d] Department of Surgery, Louisiana State University Health Sciences Center, New Orleans, Louisiana

JOURNAL OF SURGICAL RESEARCH 185 (2013) 294–299

Conclusiones:

Durante la resucitación de control de daños

- Empleo de volúmenes **elevados** de **cristaloides** → **disminución** de la supervivencia
- Empleo de volúmenes **bajos** de **coloides** → **incremento** de la supervivencia

Place of the colloids in fluid resuscitation of the traumatized patient

Michael F.M. James

Purpose of review
The examination of the recent literature aimed at analysing the most recent data that could affect decisions regarding the use of colloids in trauma resuscitation.

Recent findings
Animal data have generally shown a beneficial effect of colloids in trauma resuscitation, with improvements in capillary leak demonstrated in lung, intestine and brain. In most studies, hydroxyethyl starch resuscitation was more effective than crystalloid and decreased markers of inflammatory processes were observed. Brain injury in animals was attenuated with colloids. In uncontrolled haemorrhage, resuscitation with colloid increased bleeding and mortality.
Human studies have also failed to confirm the suggestion that albumin resuscitation may be associated with a worse outcome in head injury. However, there is a strong suggestion that aggressive prehospital resuscitation, particularly with colloid, may be harmful. Studies in burns have consistently shown an improvement in the tendency to fluid overload with the inclusion of colloid in the resuscitation strategy, but so far no outcome benefit has been shown.
Two studies of general trauma resuscitation have shown apparent benefit from the use of HES in early resuscitation with reductions in mortality and in renal injury.

Summary
Recent trauma studies provide ongoing, but not conclusive, evidence of a benefit from colloid resuscitation in trauma.

Keywords
colloids, crystalloids, fluid therapy, trauma

British Journal of Anaesthesia 112 (1): 25–34 (2014)
Advance Access publication 17 September 2013 · doi:10.1093/bja/aet303

REVIEW ARTICLES

Incidence of postoperative death and acute kidney injury associated with i.v. 6% hydroxyethyl starch use: systematic review and meta-analysis

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[2] Charité-Universitätsmedizin Berlin, Campus Charité Mitte, Charitéplatz 1, Berlin D-10117, Germany
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Editor's key points:

- The use of hydroxyethyl starch (HES) solutions has been linked to an increase in in-hospital mortality by some clinical studies, but results have been conflicting.
- HES solutions have also been implicated in causing kidney injury.
- This systematic review and meta-ana consistent or renal fu reviewing incorporat papers.
- However, was also f authors c are unabl the continued use of 6% HES solutions.

Background. Trials suggest that the use of i.v. hydroxyethyl starch (HES) solutions is associated with increased risk of death and acute kidney injury (AKI) in critically ill patients. It is uncertain whether similar adverse effects occur in surgical patients.

Methods. Systematic review and meta-analysis of trials in which patients were randomly allocated to 6% HES solutions or alternative i.v. fluids in patients undergoing surgery. Ovid Medline, Embase, Cinhal, and Cochrane Database of Systematic Reviews were searched for trials comparing 6% HES with clinically relevant non-starch comparator. The primary end-point was hospital mortality. Secondary endpoints were requirement for renal replacement therapy (RRT) and author-defined AKI. Pre-defined subgroups were cardiac and non-cardiac surgery.

Results. Four hundred and fifty-six papers were identified; of which 19 met the inclusion criteria. In total, 1567 patients were included in the analysis. Dichotomous outcomes

Conclusions. We did not identify any differences in the incidence of death or AKI in surgical patients receiving 6% HES. Included studies were small with low event rates and low risk of heterogeneity. Narrow CIs suggest that these findings are valid. Given the absence of demonstrable benefit, we are unable to recommend the use of 6% HES solution in surgical patients.

Keywords: hetastarch; meta-analysis; surgery

Accepted for publication: 2 July 2013

Fluid therapy in critical illness: a special focus on indication, the use of hydroxyethyl starch and its different raw materials

Christian Ertmer, Tim Kampmeier, and Hugo Van Aken

Purpose of review
Fluid therapy is a complex intervention with insufficient resuscitation, as well as overinfusion and fluid accumulation being associated with adverse outcomes. Early goal-directed therapy with later conservative fluid management (i.e. prevention of positive fluid balance and weight gain) appears to markedly improve the survival of patients with severe sepsis. The impact of colloids in resuscitation of patients with sepsis has been the topic of several recently published studies. The purpose of the present review is to outline the indication of fluid administration in critically ill patients, discuss the recent findings of trials involving hydroxyethyl starch (HES) solutions and highlight the impact of different raw materials for HES synthesis.

Recent findings
Pragmatic trials of modern HES solutions versus crystalloids in critically ill patients show either no difference or adverse outcomes associated with HES infusion. However, fluid therapy was not protocolized in most

Summary
Adverse effects of fluid resuscitation in critically ill patients appear to be a consequence of dose and timing rather than the type of fluid itself. Modern waxy maize-derived 6% HES 130/0.4 may have advantages over crystalloids in the very early course of the disease. Clinical trials of early, goal-directed and protocolized therapy with innovative endpoints of resuscitation comparing balanced crystalloids and balanced, waxy maize-derived 6% HES 130/0.4 as the initial resuscitation fluid are warranted.

Keywords
acute kidney injury, fluid therapy, hydroxyethyl starch, transfusion

British Journal of Anaesthesia **113** (3): 459–67 (2014)
Advance Access publication 26 June 2014 · doi:10.1093/bja/aeu103

BJA

OBSTETRICS

6% Hydroxyethyl starch (130/0.4) *vs* Ringer's lactate preloading before spinal anaesthesia for Caesarean delivery: the randomized, double-blind, multicentre CAESAR trial‡

F. J. Mercier[1*], P. Diemunsch[2], A.-S. Ducloy-Bouthors[3], A. Mignon[4], M. Fischler[5], J.-M. Malinovsky[6], F. Bolandard[7], A. G. Aya[8], M. Raucoules-Aimé[9], D. Chassard[10], H. Keita[11], A. Rigouzzo[12] and A. Le Gouez[1], the CAESAR Working Group[†]

Background. Vasopressor administration is recommended to prevent hypotension during spinal anaesthesia (SA) for elective Caesarean delivery. We aimed to test the superior efficacy and ensure safety of a hydroxyethyl starch (HES) *vs* a Ringer's lactate (RL) preloading, when combined with a phenylephrine-based prophylaxis.

Methods. A total of 167 healthy parturients undergoing elective Caesarean delivery under SA were included in this multicentre, randomized, double-blind study. Patients received 500 ml of 6% HES (130/0.4)+500 ml of RL (HES group) or 1000 ml of RL (RL group) i.v. before SA. After SA, i.v. phenylephrine boluses were titrated when systolic arterial pressure (SAP) was below 95% of baseline. The primary outcome was the incidence of maternal hypotension (SAP<80% of baseline).

Results. The incidence of both hypotension and symptomatic hypotension (i.e. with dizziness, nausea/vomiting, or both) was significantly lower in the HES group *vs* the RL group: 36.6% *vs* 55.3% (one-sided $P=0.025$) and 3.7% *vs* 14.1%. There was no significant difference in total phenylephrine requirements [median (range): 350 (50–1800) *vs* 350 (50–1250) μg]. The dec
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Conclusions. Compared with a pure RL preloading, a mixed HES–RL preloading significantly improved prevention of both hypotension and symptomatic hypotension based on early phenylephrine bolus administration and did not induce adverse effects.

Effects of intraoperative colloid administration on outcome in a population-based general surgical cohort: a propensity score analysis

J. CANET [1], S. SABATÉ [2], V. MAZO [1]

Department of Anesthesiology, Hospital Universitari Germans Trias i Pujol. Universitat Autònoma de Barcelona, Badalona, Spain; [2]Department of Anesthesiology, Fundació Puigvert, Barcelona, Spain on behalf of the ARISCAT group*

TABLE IV.—*Incidence of postoperative complications according to whether colloids were received or not, stratified by intraoperative blood loss and hypotension.*

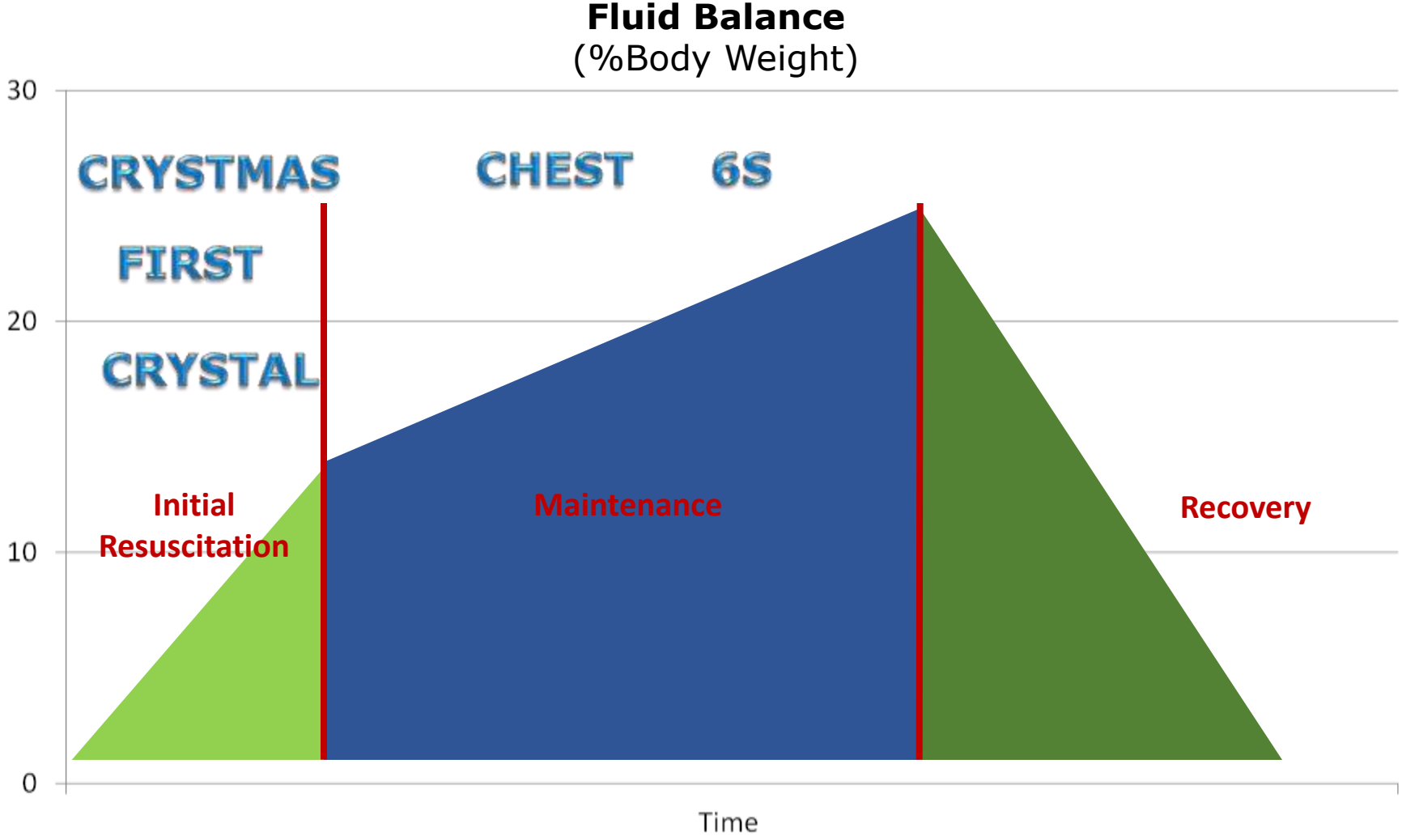
		Colloid Administration	No. of Patients	Bronchospasm	P*	Respiratory Infection*	P*
Intraoperative blood loss†	≤500 mL	No	1868	12 (0.6)	< 0.001	7 (0.4)	< 0.001
		Yes	401	22 (5.5)		24 (6.0)	
	>500 mL	No	34	2 (5.9)	1.000	2 (5.9)	0.960
		Yes	154	7 (4.5)		6 (3.9)	
Intraoperative hypotension‡	No	No	1788	12 (0.7)	< 0.001	9 (0.5)	< 0.001
		Yes	415	19 (4.6)		18 (4.3)	
	Yes	No	118	2 (1.7)	0.040	0 (0.0)	< 0.001
		Yes	141	10 (7.1)		12 (8.5)	

COMMENTARY Open Access

Hydroxyethyl starch - the importance of being earnest

Daniel Chappell and Matthias Jacob*

Fluid Therapy in Critically ill patients



Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012

R. Phillip Dellinger, MD[1]; Mitchell M. Levy, MD[2]; Andrew Rhodes, MB BS[3]; Djillali Annane, MD[4]; Herwig Gerlach, MD, PhD[5]; Steven M. Opal, MD[6]; Jonathan E. Sevransky, MD[7]; Charles L. Sprung, MD[8]; Ivor S. Douglas, MD[9]; Roman Jaeschke, MD[10]; Tiffany M. Osborn, MD, MPH[11]; Mark E. Nunnally, MD[12]; Sean R. Townsend, MD[13]; Konrad Reinhart, MD[14]; Ruth M. Kleinpell, PhD, RN-CS[15]; Derek C. Angus, MD, MPH[16]; Clifford S. Deutschman, MD, MS[17]; Flavia R. Machado, MD, PhD[18]; Gordon D. Rubenfeld, MD[19]; Steven A. Webb, MB BS, PhD[20]; Richard J. Beale, MB BS[21]; Jean-Louis Vincent, MD, PhD[22]; Rui Moreno, MD, PhD[23]; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

www.ccmjournal.org February 2013 • Volume 41 • Number 2

SURVIVING SEPSIS CAMPAIGN BUNDLES

TO BE COMPLETED WITHIN 3 HOURS:
1) Measure lactate level
2) Obtain blood cultures prior to administration of antibiotics
3) Administer broad spectrum antibiotics
4) Administer 30 mL/kg crystalloid for hypotension or lactate ≥4mmol/L

TO BE COMPLETED WITHIN 6 HOURS:
5) Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg
6) In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4 mmol/L (36 mg/dL):
   - Measure central venous pressure (CVP)*
   - Measure central venous oxygen saturation ($Scvo_2$)*
7) Remeasure lactate if initial lactate was elevated*

*Targets for quantitative resuscitation included in the guidelines are CVP of ≥8 mm Hg, $Scvo_2$ of ≥70%, and normalization of lactate.

G. Fluid Therapy of Severe Sepsis

1. We recommend crystalloids be used as the initial fluid of choice in the resuscitation of severe sepsis and septic shock (grade 1B).
2. We recommend against the use of hydroxyethyl starches (HES) for fluid resuscitation of severe sepsis and septic shock (grade 1B). (This recommendation is based on the results of the VISEP [128], CRYSTMAS [122], 6S [123], and CHEST [124] trials. The results of the recently completed CRYSTAL trial were not considered.)
3. We suggest the use of albumin in the fluid resuscitation of severe sepsis and septic shock when patients require substantial amounts of crystalloids (grade 2C).

Management of severe perioperative bleeding

Guidelines from the European Society of Anaesthesiology

Sibylle A. Kozek-Langenecker, Arash Afshari, Pierre Albaladejo, Cesar Aldecoa Alvarez Santullano, Edoardo De Robertis, Daniela C. Filipescu, Dietmar Fries, Klaus Görlinger, Thorsten Haas, Georgina Imberger, Matthias Jacob, Marcus Lancé, Juan Llau, Sue Mallett, Jens Meier, Niels Rahe-Meyer, Charles Marc Samama, Andrew Smith, Cristina Solomon, Philippe Van der Linden, Anne Juul Wikkelsø, Patrick Wouters and Piet Wyffels

Eur J Anaesthesiol 2013

Rational perioperative fluid management may include a combination of fixed crystalloid administration to replace extra-vascular losses (up to 2,5ml/kg/h) and individualized goal-directed colloid administration to maintain a maximal cardiac stroke volume in high risk patients and try to get a zero balance

Gelatines?

Intensive Care Med (2012) 38:1134–1142
DOI 10.1007/s00134-012-2560-x

ORIGINAL

D. O. Thomas-Rueddel
V. Vlasakov
K. Reinhart
R. Jaeschke
H. Rueddel
R. Hutagalung
A. Stacke
C. S. Hartog

Safety of gelatin for volume resuscitation—a systematic review and meta-analysis

Gelatins were introduced into clinical practice before legislation in the aftermath of the thalidomide tragedy made clinical proof of safety mandatory [6]. Despite over 60 years of clinical experience with its use, the safety of gelatin in all settings in which it is used cannot be reliably assessed and confirmed. We suggest the need to investigate and establish such safety.

Randomized study comparing the effects of hydroxyethyl starch solution with Gelofusine on pulmonary function in patients undergoing abdominal aortic aneurysm surgery

D. Rittoo[1], P. Gosling[2], S. Burnley[3], C. Bonnici[3], P. Millns[3], M. H. Simms[1], S. R. G. Smith[1] and R. K. Vohra[1]*

Br J Anaesth 2004; **92**: 61–6

Conclusion. Compared with Gelofusine, the perioperative pulmonary function of patients treated with HES after abdominal aortic aneurysm surgery was better.

The best way of assessing endothelial function is uncertain. The possible advantage of using endothelial cell function surrogates is that they reflect the net effects of a number of different molecular pathways. It appears that the effects of HES on the endothelium can be a double-edged sword that on one hand prevents excessive activation of the inflammatory process and on the other can interfere with haemostasis. This study shows that when used in the right pathophysiological states such as in abdominal aortic aneurysm repair, volume expansion with HES can confer significant benefits in terms of damping down the inflammatory cascade and endothelial cell dysfunction.

Hydroxyethyl Starch, but Not Modified Fluid Gelatin, Affects Inflammatory Response in a Rat Model of Polymicrobial Sepsis with Capillary Leakage

Xiaomei Feng, MD, PhD
Jian Liu, PhD
Min Yu, PhD
Sihai Zhu, MD
Jianguo Xu, MD, PhD

BACKGROUND: Intravascular volume therapy is crucial in septic patients to improve tissue perfusion and maintain stable hemodynamics. Modified fluid gelatins (MFG) and medium weight hydroxyethyl starches (HES) are the most widely used synthetic colloids. Our aim in this study, performed in septic rats challenged by cecal ligation and puncture (CLP), was to investigate the effects of HES and MFG on pulmonary capillary leakage and to determine whether an antiinflammatory mechanism was involved.

METHODS: Animals were randomly allocated to eight groups: saline control; CLP and saline; CLP and HES (7.5, 15, and 30 mL/kg); CLP and MFG (7.5, 15, and 30 mL/kg). Each group had 20 rats, 10 of which were used for pulmonary capillary leakage and 10 for other measurements. Four hours after CLP, the specified doses

CONCLUSIONS: HES may attenuate capillary leakage by modulating an inflammatory response, whereas an antiinflammatory mechanism was not involved in the effects of MFG on capillary leakage.

(Anesth Analg 2007;104:624-30)

(Anesth Analg 2007;104:624-30)

Effects of Intravascular Volume Replacement on Lung and Kidney Function and Damage in Nonseptic Experimental Lung Injury

Pedro L. Silva, Ph.D.,* Andreas Güldner, M.D.,† Christopher Uhlig, M.D.,‡ Nadja Carvalho, M.Sc.,§ Alessandro Beda, Ph.D.,‖ Ines Rentzsch, Ph.D.,# Michael Kasper, Ph.D.,** Bärbel Wiedemann, Ph.D.,†† Peter M. Spieth, M.D.,‡‡ Thea Koch, M.D., Ph.D.,§§ Vera L. Capelozzi, M.D., Ph.D.,‖‖ Paolo Pelosi, M.D.,## Patricia R. M. Rocco, M.D., Ph.D.,*** Marcelo Gama de Abreu, M.D., Ph.D.†††

What We Already Know about This Topic

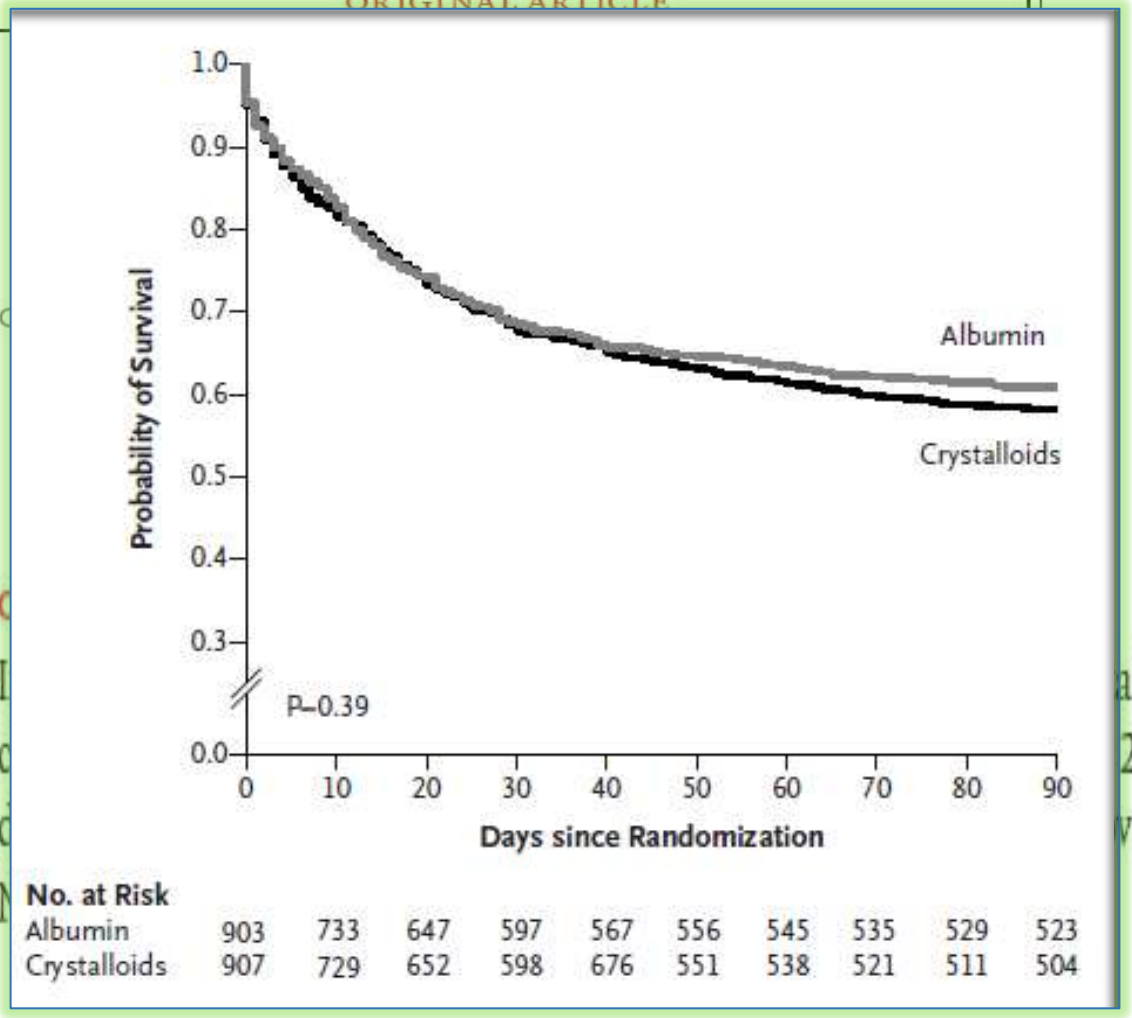
- Keeping intravascular volume decreased in acute lung injury improves outcomes but is difficult during major hemorrhage

What This Article Tells Us That Is New

- Intravascular volume expansion with hydroxyethyl starch led to less lung injury compared to Ringer's acetate and less renal damage than gelatin-polysuccinate in experimental acute lung injury after major hemorrhage

Albúmina?

ORIGINAL ARTICLE



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This article was published on March 18, 2014, at NEJM.org.

Med Intensiva. 2013;37(6):409–415

medicina *intensiva*

www.elsevier.es/medintensiva

PUNTO DE VISTA

Nuevas recomendaciones sobre la utilización de soluciones de albúmina humana en pacientes con sepsis grave y shock séptico. Una evaluación crítica de la literatura

J. Latour-Pérez

Hospital General Universitario de Elche, Elche, Alicante, España

PALABRAS CLAVE
Sepsis;
Shock séptico;
Albúmina;
Revisión sistemática;
Guías de práctica clínica

Resumen La tercera edición de las guías de la *Surviving Sepsis Campaign* de 2012 abre las puertas a la utilización de albúmina en el soporte hemodinámico de los pacientes con sepsis grave y shock séptico. Estas recomendaciones se apoyan en un reciente metaanálisis que incluye estudios con indicios de una insuficiente expansión plasmática en el grupo control y estudios realizados en niños con malaria con clara heterogeneidad estadística (p de interacción = 0,02). Al excluir estos últimos, el intervalo de confianza del estimador de efecto fue compatible con un exceso de mortalidad en el grupo tratado con albúmina (OR = 0,87 [IC 95%: 0,71-1,07]). Tras la publicación del metaanálisis se han comunicado los resultados de nuevos estudios aleatorizados que no han encontrado beneficio en los pacientes tratados con albúmina. Dada la incertidumbre acerca del verdadero efecto de la albúmina (debido a la existencia de datos indirectos y a imprecisión) y el coste de la albúmina, se sugiere *no utilizar* albúmina en la reanimación inicial de pacientes con sepsis grave y shock séptico (GRADE 2C).

Comparison of the effects of albumin 5%, hydroxyethyl starch 130/0.4 6%, and Ringer's lactate on blood loss and coagulation after cardiac surgery

K. Skhirtladze[1], E. M. Base[1]*, A. Lassnigg[1], A. Kaider

British Journal of Anaesthesia **112** (2): 255–64 (2014)

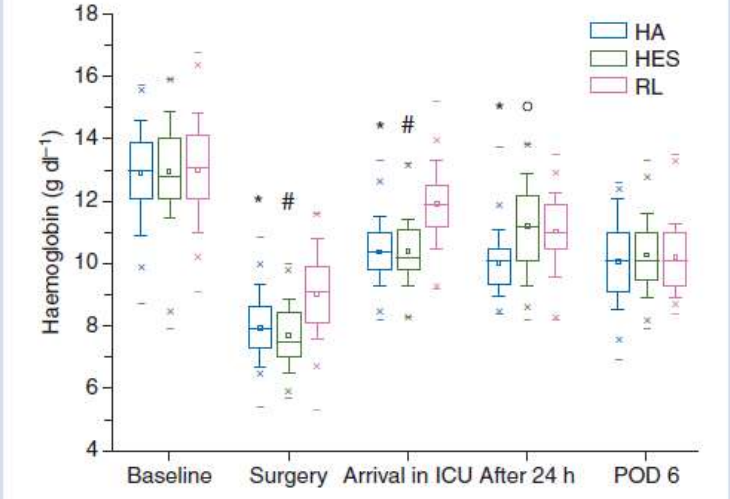
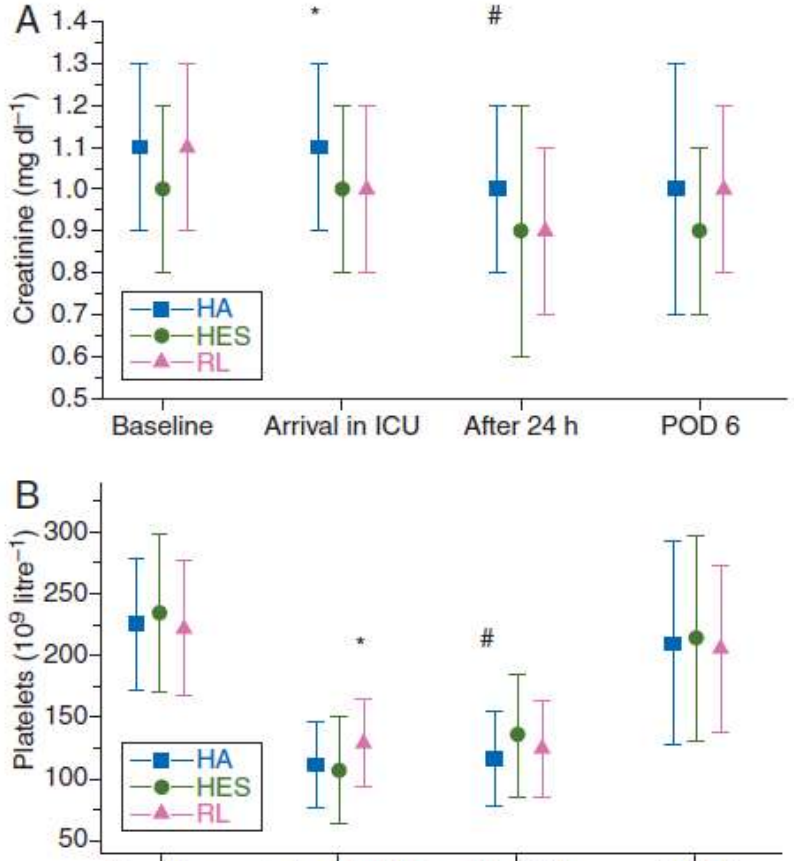


Fig 2 Course of Hb concentration. *$P<0.05$ HA *vs* RL; #$P<0.05$ HES *vs* RL; ○$P<0.05$ HES *vs* HA.



Conclusions. Despite equal blood loss from chest drains, both colloids interfered with blood coagulation and produced greater haemodilution, which was associated with more transfusion of blood products compared with crystalloid use only.

Meybohm et al. Critical Care 2013, 17:R166
http://ccforum.com/content/17/4/R166

CRITICAL CARE

RESEARCH Open Access

Re-evaluating currently available data and suggestions for planning randomised controlled studies regarding the use of hydroxyethyl starch in critically ill patients - a multidisciplinary statement

Patrick Meybohm[1], Hugo Van Aken[2], Andrea De Gasperi[3], Stefan De Hert[4], Giorgio Della Rocca[5], Armand RJ Girbes[6], Hans Gombotz[7], Bertrand Guidet[8], Walter Hasibeder[9], Markus W Hollmann[10], Can Ince[11], Matthias Jacob[12], Peter Kranke[13], Sibylle Kozek-Langenecker[14], Stephan Alexander Loer[15], Claude Martin[16], Martin Siegemund[17], Christian Wunder[13] and Kai Zacharowski[1*]

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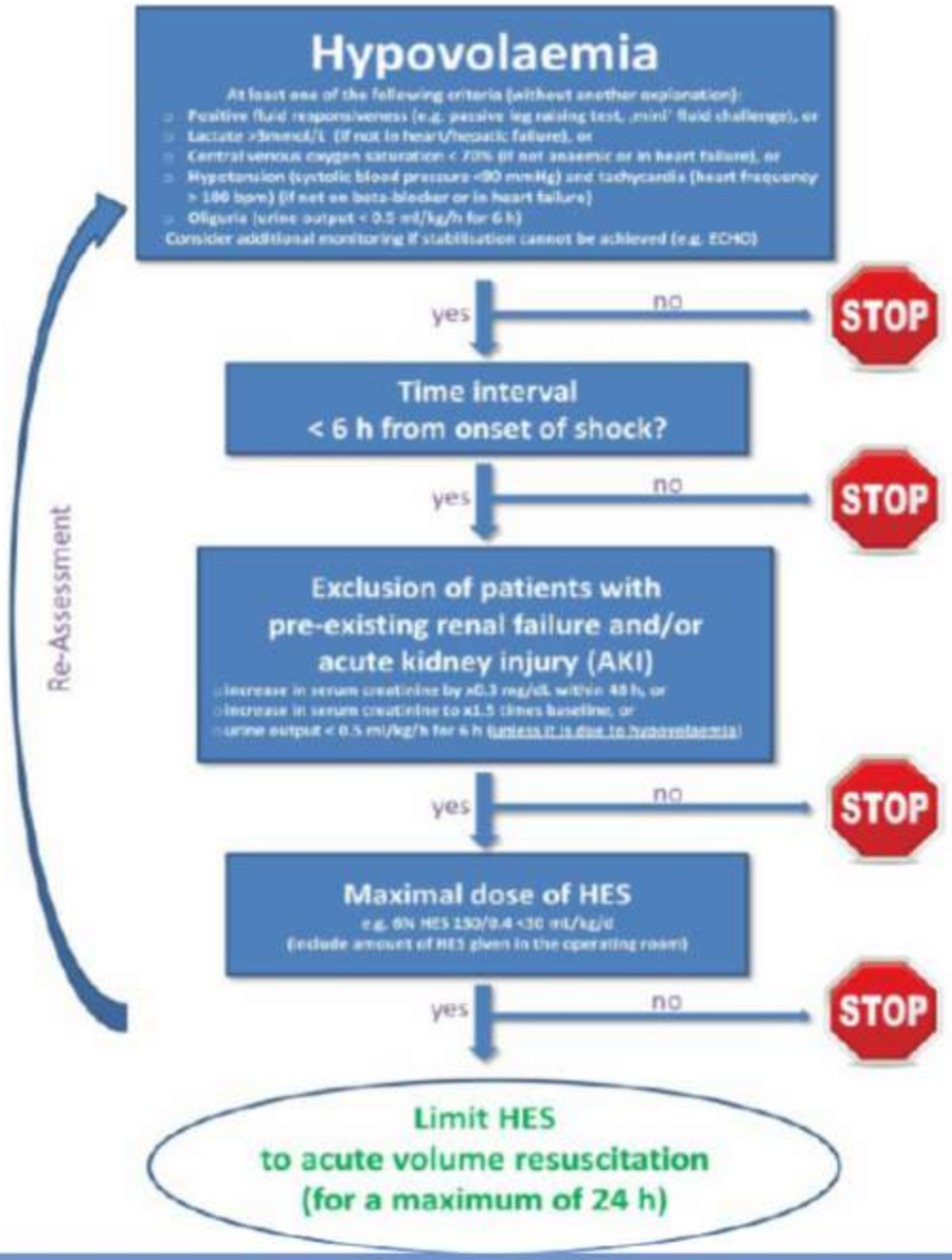

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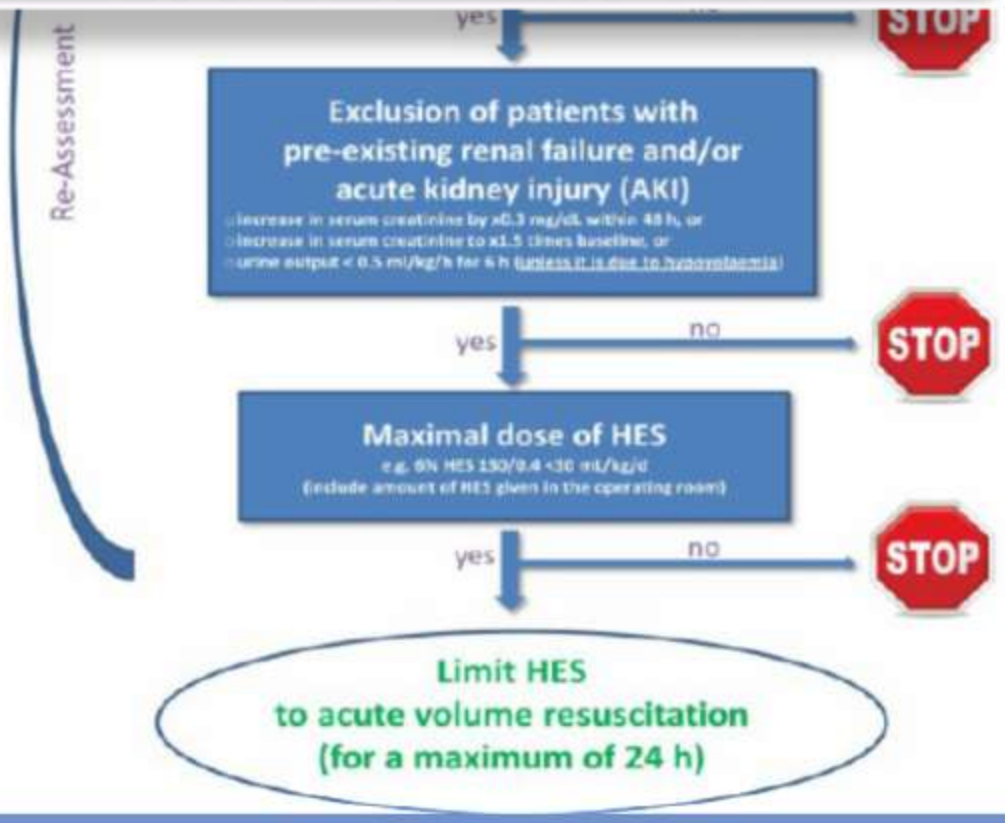
Hypovolaemia

At least one of the following criteria (without another explanation):

- **Positive fluid responsiveness (e.g. passive leg raising test, ‚mini' fluid challenge), or**
- **Lactate >3mmol/L (if not in heart/hepatic failure), or**
- **Central venous oxygen saturation < 70% (if not anaemic or in heart failure), or**
- **Hypotension (systolic blood pressure <90 mmHg) and tachycardia (heart frequency > 100 bpm) (if not on beta-blocker or in heart failure)**
- **Oliguria (urine output < 0.5 ml/kg/h for 6 h)**

Consider additional monitoring if stabilisation cannot be achieved (e.g. ECHO)



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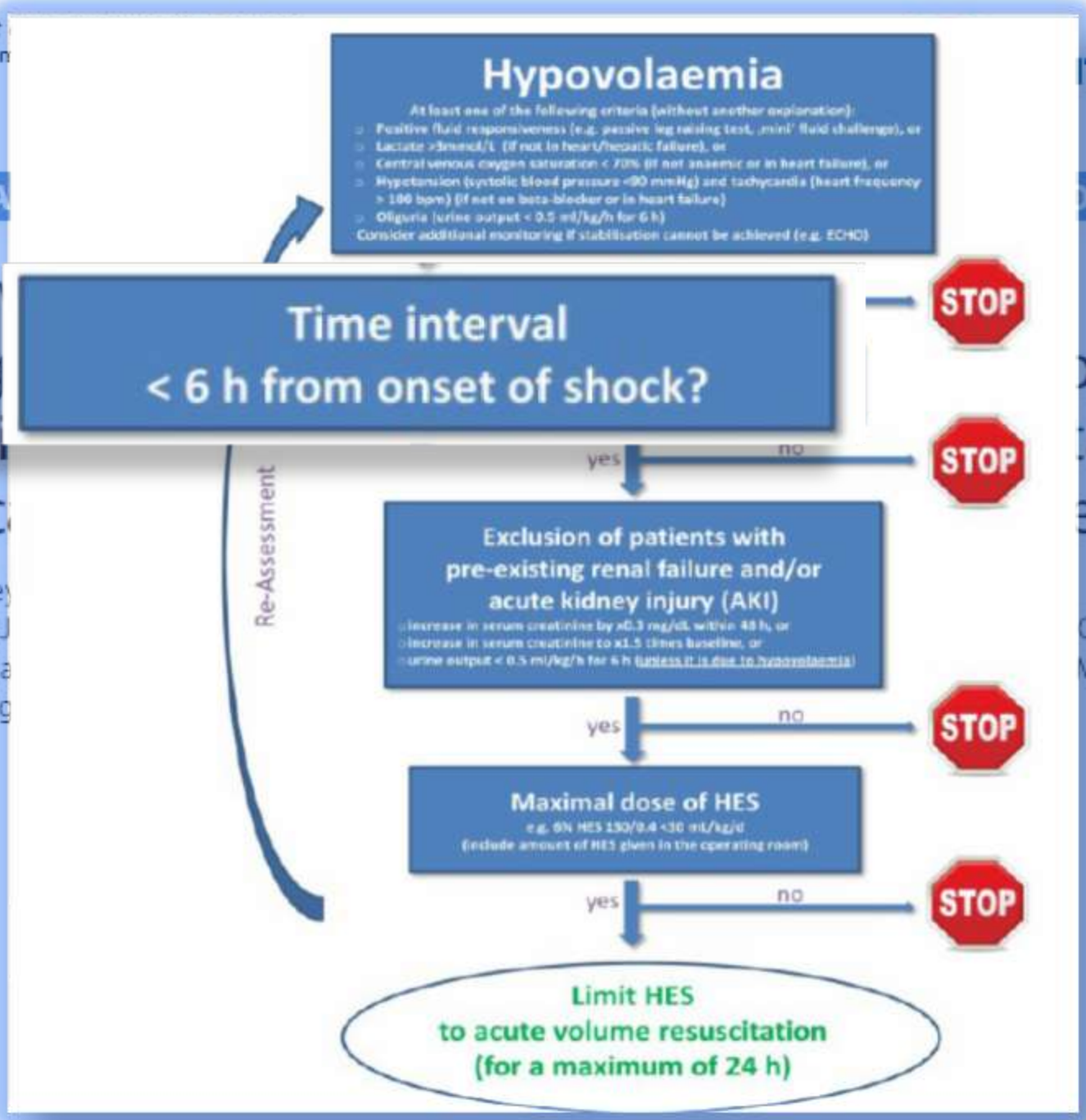

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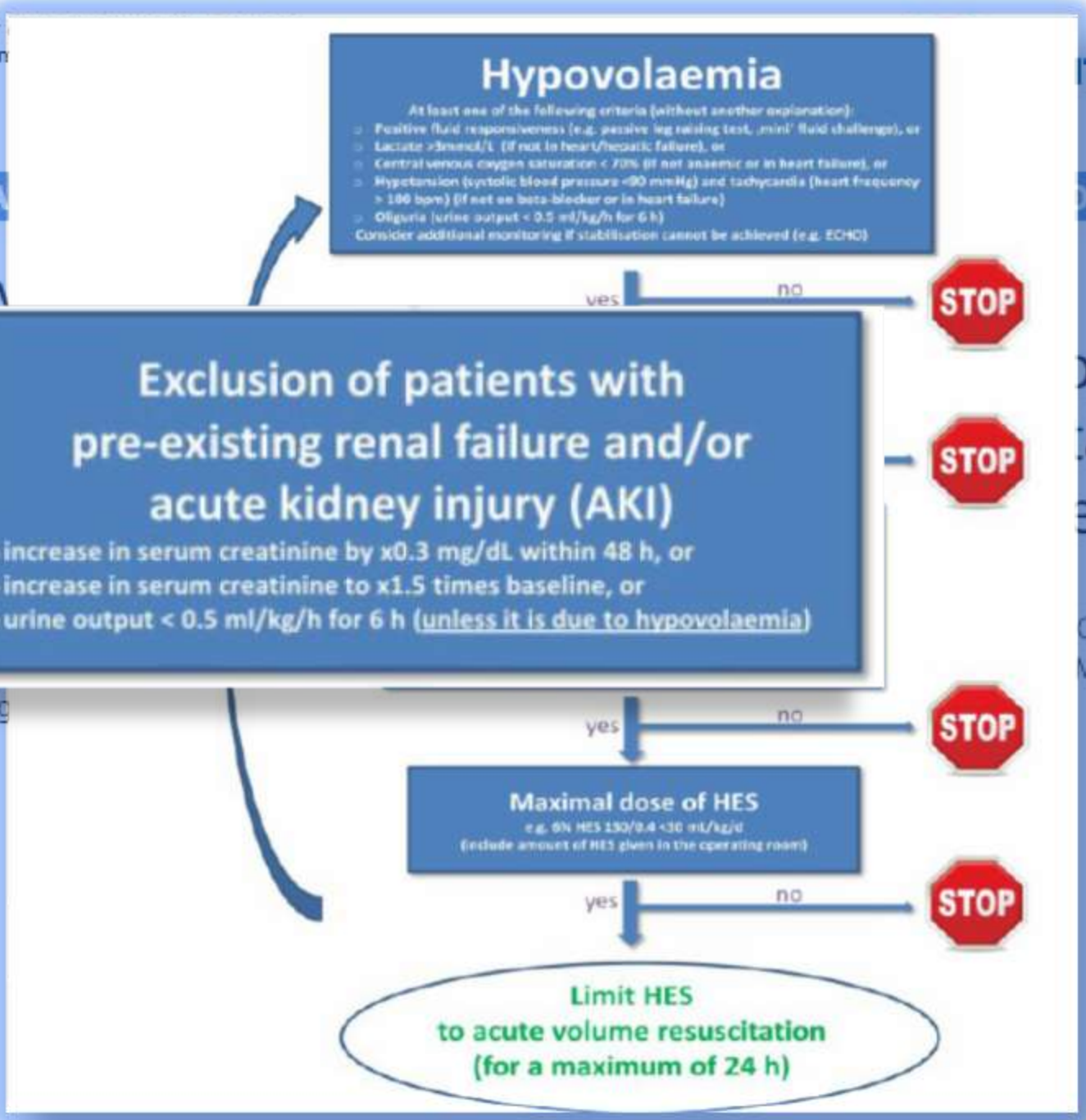

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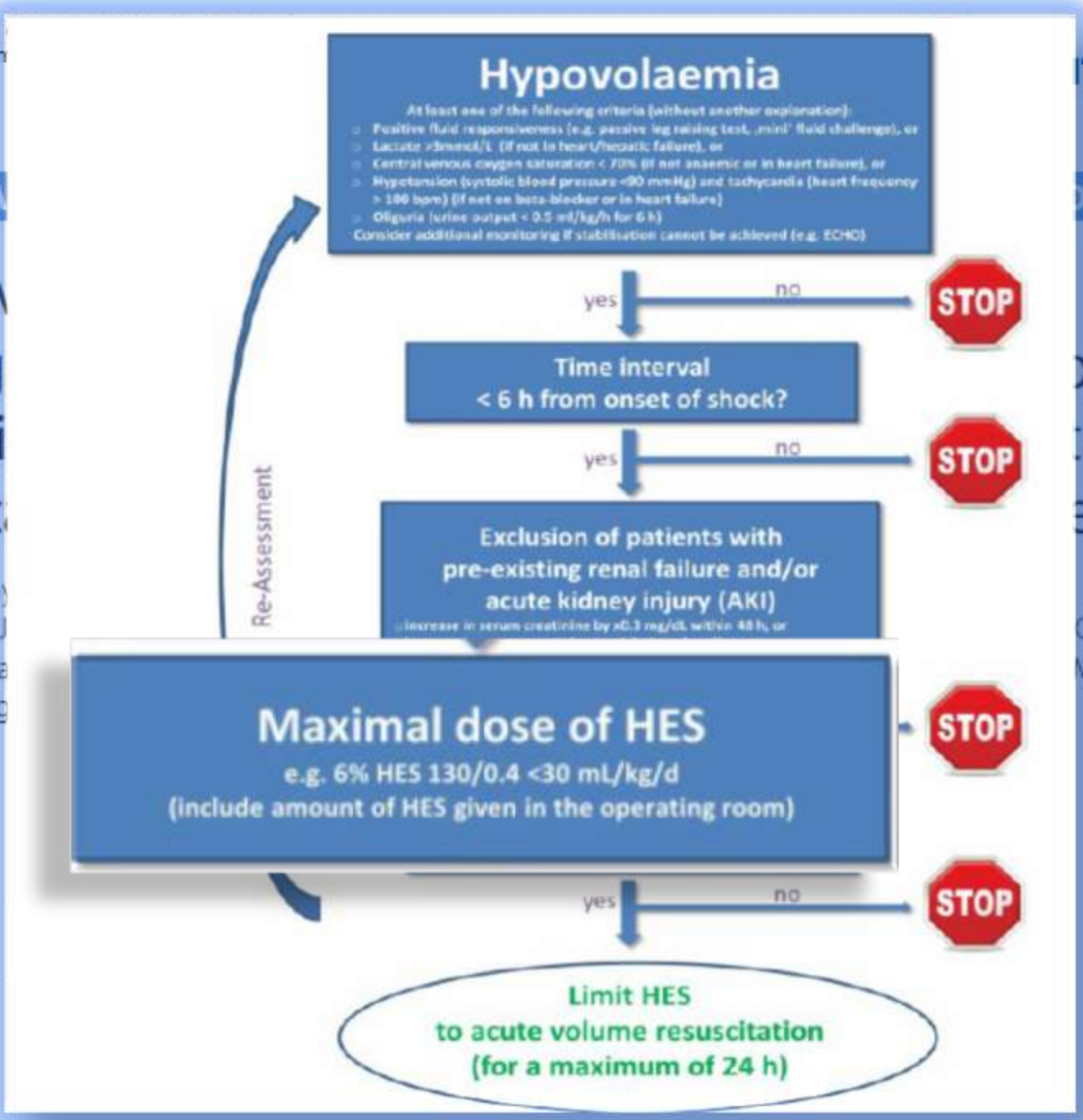

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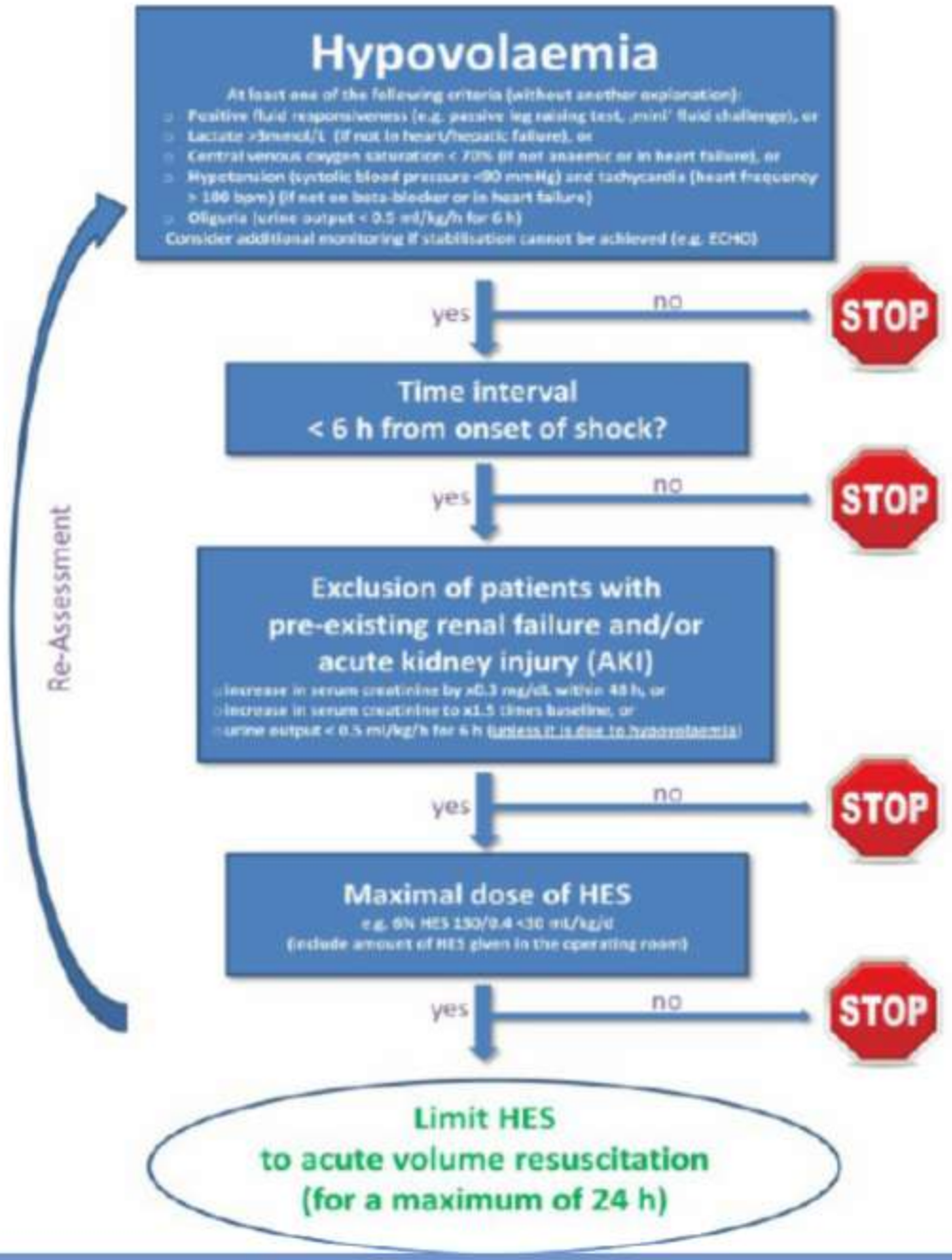

Table 1 Overview of the analogy of prescribing fluid therapy and prescribing a drug

Steps for prescribing a drug	Prescribing an oral hypoglycemic medication	Prescribing fluid therapy
Define the clinical problem	Diabetes mellitus	Hypovolemia or other fluid responsive state
Specify the therapeutic objective	Lower blood glucose	Restore absolute/ relative fluid deficit
Verify the suitability of the drug	Class of oral hypoglycemic agent	Crystalloid, colloid or blood product
Write a prescription to start the drug	Order written by MD, verified and dispensed by pharmacy	Order written by MD, verified by pharmacy, blood bank or RN, administered by RN
Monitor therapeutic response of the drug	Blood glucose or hemoglobin A1C, evidence of adverse effect/ toxicity	Monitor hemodynamic profile and end-organ perfusion, evidence of dose-response toxicity
Write an order to discontinue	Order written by MD, verified by pharmacy	Order written by MD, administered by RN

Adapted from Raghunathan *et al*[58].

Reflexions:

- Els fluids son un medicament i com a tal tenen unes indicacions, contraindicacions, dosis, ...
- Els líquids de reposició per excel·lència son els cristal·loides balancejats
- Els líquids de reposició per situacions de hipovolemia aguda son els col·loides
- Els col·loides permeten disminuir el volum total de reanimació
- La reposició volèmica s'ha de guiar per paràmetres dinàmics mes que per paràmetres estàtics (PVC, diüresis,...)
- Els col·loides ideals son els midons de índex de substitució 140/0.3, amb les alertes que des del PRAC s'han llençat
- El futur de la reposició volèmica passa per la protecció del glicocàlix

Gracies

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